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The activation loop tyrosine 823 is essential for the transforming capacity of the c-Kit oncogenic mutant D816V

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Abstract

Oncogenic c-Kit mutations have been shown to display ligand-independent receptor activation and cell proliferation. A substitution of aspartate to valine at amino acid 816 (D816V) is one of the most commonly found oncogenic c-Kit mutation and is found in more than 90% of cases of mastocytosis and less commonly in germ cell tumors, core-binding factor acute myeloid leukemia and mucosal melanomas. The mechanisms by which this mutation leads to constitutive activation and transformation are not fully understood. Previous studies have shown that the D816V mutation causes a structural change in the activation loop resulting in weaker binding of the activation loop to the juxtamembrane domain. In this paper we have investigated the role of Y823, the only tyrosine residue in the activation loop, and its role in oncogenic transformation by c-Kit/D816V by introducing the Y823F mutation. Although dispensable for the kinase activity of c-Kit/D816V, the presence of Y823 was crucial for cell proliferation and survival. Furthermore, mutation of Y823 selectively down-regulates the Ras/Erk and Akt pathways as well as the phosphorylation of STAT5 and reduces the transforming capacity of the D816V/c-Kit *in vitro*. We further show that mice injected with cells expressing c-Kit/D816V/Y823F display significantly reduced tumor size as well as tumor weight compared to controls. Finally, microarray array analysis, comparing Y823F/D816V cells with cells expressing c-Kit/D816V, demonstrate that mutation of Y823 causes up-regulation of pro-apoptotic genes whereas genes of survival pathways are down-regulated. Thus, phosphorylation of Y823 is not necessary for kinase activation, but essential for the transforming ability of the c-Kit/D816V mutant.

Key words: c-Kit; D816V, Y823F, activation loop, tyrosine phosphorylation, signaling, transformation, cancer

Introduction

c-Kit is a type III receptor tyrosine kinase (RTK) that is expressed on the surface of hematopoietic progenitor cells, mast cells, germ cells, melanocytes and interstitial cells of Cajal.[1, 2] Its physiological ligand stem cell factor (SCF) binds to c-Kit resulting in dimerization of the receptors and a conformational change comprising release of the auto-inhibitory constraint that the juxtamembrane domain (JMD) poses on the kinase domain, outward opening of the activation loop and sequential phosphorylation of tyrosine residues in the cytoplasmic region of the receptor. [3] These events in turn activate the signaling cascades through binding, phosphorylation and activation of various signaling molecules. Oncogenic activating mutations in c-Kit have been described in various tumors in the tissues where c-Kit is normally expressed. [2, 4] The most commonly found mutation in c-Kit is a single point mutation resulting from the substitution of an aspartate to a valine at position 816 (D816V) which is found in almost all cases of systemic mastocytosis and less commonly in so-called core-binding factor leukemia,[5, 6] germ cell tumors and melanomas.[4, 7, 8] This mutation results in ligand-independent autoactivation of c-Kit [9] which is followed by activation of multiple signaling cascades[10-12] all contributing to aberrant gene expression and tumor progression. This makes D816V a target for small molecule tyrosine kinase inhibitors like dasatinib, PKC 412 and SU-5416[13-17] which either directly inhibit D816V or target the downstream effectors controlling mast cell proliferation or cell survival.[18] Although a number of such molecules have been in clinical trials, problems with low efficacy, target specificity and resistance to inhibitors remains a major limitation of most inhibitors. Imatinib is a well-known inhibitor of wild-type c-Kit. However, it is not an effective inhibitor of the D816V mutant. [19]

The activation loop (A-loop) present at the C-terminus of the kinase domain spans about 25 amino acids of the c-Kit receptor and is a region known for a number of activating mutations

including the D816V mutation. Upon activation, the A-loop positions itself in the so-called DFG-in state allowing the phosphotransfer from ATP to the tyrosine hydroxyl groups on the receptor. The DFG motif is a conserved tripeptide sequence (DFG) present in the N-terminus of the A-loop. In the active kinase conformation, the A-loop extends over the carboxyterminus of the catalytic pocket and the DFG motif moves away from the ATP binding region (DFG-in) and thereby creates an active conformation of the kinase. Previous studies show that Y823 is crucial for maintaining receptor stability rather than kinase activity.[20] It has been also shown that the network via which JMD and A-loop communicate is disturbed by D816V mutation, however introduction of a D792E mutation in the A-loop restores this interaction pattern.[3]

In this study, we have investigated the effects of mutating Y823 to phenylalanine (Y823F) on oncogenic c-Kit/D816V signaling. We show that Y823F renders c-Kit/D816V expressing cells far more sensitive to apoptosis than the cells having Y823 intact. Cell proliferation was also severely reduced in cells expressing the c-Kit/D816V/Y823F compared to cells expressing c-Kit/D816V. Furthermore, the transforming capability of the c-Kit oncogenic mutant was hampered as the cells containing the c-Kit/D816V/Y823F double mutant were unable to phosphorylate STAT5 and lost the ability to form colonies in semi-solid medium. A reduction in phosphorylation of the adaptor proteins Cbl and Shc was also observed. The PI3-kinase/Akt and the Ras/Erk pathways were further perturbed. Tumors formed in mice by Ba/F3 cells expressing the c-Kit/D816V/Y823F double mutant were severely reduced in volume and weight compared to mice injected with c-Kit/D816V expressing cells. Taken together, our data suggests that cells expressing Y823F mutation can counter balance the uncontrolled proliferation and inhibited apoptosis of c-Kit/D816V expressing cells.

Results

Y823F mutation does not affect total tyrosine phosphorylation but reduces cell proliferation

We have previously demonstrated that the kinase activity of wild-type c-Kit is unaffected by the Y823F mutation.[21] Therefore, we wanted to assess whether mutation of Y823 affects the kinase activity of c-Kit/D816V. To this end we generated the Y823F mutant in c-Kit/D816V background stably transfected into Ba/F3 cells since they lack endogenous c-Kit expression (Fig. 1A). Cell lines expressing c-Kit/D816V/Y823 and c-Kit/D816V, respectively, were analyzed for phosphorylation of c-Kit. In addition to stably transfected cells, we used transiently transfected COS-1 cells (which similar to Ba/F3 cells also lack endogenous c-Kit expression). The absence of phosphorylation at Y823 was confirmed by Western blotting using a pY823 specific antibody (Fig. 1B). In agreement with our data on wild-type c-Kit, the Y823F mutation did not impair c-Kit/D816V autophosphorylation (Fig. 1B). The intensity of the phosphotyrosine antibody signal was quantitated and normalized for c-Kit expression, further demonstrating that there was no difference in kinase activity due to the presence of the Y823F mutation (Fig. 1C). Taking together, this suggests that Y823 is not involved in the regulation of the kinase activity of c-Kit/D816V.

It has previously been shown that cells expressing the c-Kit/D816V mutant display lower cell surface expression of the receptor than cells expressing wild-type c-Kit.[22] It was demonstrated that this was dependent on the kinase activity of c-Kit, since it could be reversed by treatment with a tyrosine kinase inhibitor.[23] We could by flow cytometry analysis demonstrate that introduction of the Y823F mutation did not alter cell surface expression of c-Kit (Fig. 1A). We next wanted to assess whether the Y823F mutation led to any phenotypic changes and analyzed cell proliferation by flow cytometry following EdU staining. Proliferation was

significantly reduced in cell expressing c-Kit/D816V/Y823F as compared to cells expressing the c-Kit/D816V mutant (Fig. 1D). This suggests that while the Y823 site is dispensable for kinase activity, it is involved in signaling downstream of c-Kit/D816V.

Y823 is required for intact Erk and Akt pathway signaling in c-Kit/D816V expressing cells

The D816V mutation induces ligand-independent activation of c-Kit followed by sequential recruitment of several signaling molecules that initiate signaling cascades leading to proliferation, survival and transformation. Despite being constitutively active, the D816V mutant has been reported to only weakly activate Erk and Akt in the absence of SCF[24, 25] while, in murine myeloid progenitor cells, the D816V mutation renders the regulatory subunit of PI3K constitutively phosphorylated but not Akt and Erk1/2.[11] We show that Ba/F3 cells expressing c-Kit/D816V responded to SCF stimulation with strong phosphorylation of Akt, while Erk and p38 phosphorylation was constitutive. In the presence of the Y823F mutation, the phosphorylation of Akt as well as Erk were strongly reduced (Fig. 2A and 2B). In contrast, phosphorylation of p38 was constitutive and unaffected by the Y823F mutation (Fig. 2A and B). These data suggest that Y823 is involved in signaling downstream of c-Kit/D816V in a selective manner.

Both cell survival and proliferation are significantly reduced by Y823F mutation

We wanted to ascertain whether the mutation of Y823 in c-Kit had an effect on cell survival. As a complement to the EdU incorporation method, the effect of the Y823F mutation on cell proliferation and survival was investigated by the trypan blue exclusion method. The number of living cells was significantly reduced in cells expressing the c-Kit/D816V/Y823F double mutant (Fig. 3A). In addition, the effect of the Y823F mutation on D816V-mediated cell survival was examined by staining the cells with Annexin V and 7-Amino Actinomycin D and

analyzed by flow cytometry. Ba/F3 cells expressing the c-Kit/D816V/Y823F mutant showed more than 40% reduction in cell survival compared to cells expressing c-Kit/D816V (Fig. 3B). These findings are in agreement with the lowered activation of Akt and Erk in the cells expressing c-Kit/D816V/Y823F.

Y823F mutation abolishes the ability of c-Kit/D816V to form colonies in methylcellulose and reduces the phosphorylation of STAT5

As we observed a marked decrease in both Akt and Erk1/2 phosphorylation in cells expressing c-Kit/D816V/Y823F, we wanted to investigate whether this mutation also affects the growth in semi-solid medium. Ba/F3 cells devoid of growth factors and cytokines were mixed with methylcellulose colony medium and incubated under humidified conditions for 8 days while c-Kit/D816V was able to form colonies, introduction of the Y823F mutation dramatically diminished the ability to form colonies or cell clusters (Fig. 4A). This is in agreement with our data demonstrating an increased apoptosis and reduced proliferation of Ba/F3 cells harboring the c-Kit/D816V/Y823F mutant.

Signal transducer and activator of transcription (STAT) proteins have been described to transduce signals from the membrane-bound receptors to the cell nucleus through the classical JAK-STAT pathway.[26] Activation of STAT proteins has been linked to the expression of genes that are crucial for cell proliferation, differentiation and survival. While STAT1, STAT3 and STAT5 were tyrosine phosphorylated in D816V-transformed cells, only STAT5 was shown to be transcriptionally active in the mast cell line HMG-1.2 that carries the D816V mutation.[27] We, therefore, aimed to investigate if phosphorylation of STAT5 was affected by the Y823F mutation. Serum-starved cells were subjected to immunoprecipitation with an anti-STAT5 antibody and phosphorylation was detected by Western blotting using a phosphotyrosine antibody. We observed a marked reduction in phosphorylation of STAT5 in

cells expressing the c-Kit/D816V/Y823F mutant compared to c-Kit/D816V expressing cells (Fig. 4B and 4C). This suggests the importance of activated STAT5 in mediating signaling crucial for cell proliferation, survival and probably in the ability of the oncogenic mutant to form colonies in semi-solid media.

The Y823F mutation in c-Kit/D816V leads to a reduction in both tumor weight and volume in athymic mice

To investigate the tumor forming capacity, five athymic mice were injected with Ba/F3 cells expressing the c-Kit/D816V and c-Kit/D816V/Y823F mutants, respectively. All but one animal developed solid tumors which were isolated and measured for both weight and volume. Interestingly, one of the mice carrying cells with the Y823F mutation did not develop any detectable tumor. The four other mice carrying the c-Kit/D816V/Y823F mutant cells developed tumors that were significantly smaller as compared with the c-Kit/D816V mutant controls. (Fig. 5A). Average tumor weight (Fig. 5B) and tumor volume (Fig. 5C) were reduced by almost 80% in mice injected with cells expressing the c-Kit/D816V/Y823F mutant.

Mutation of Y823 leads to upregulation of tumor suppressor genes and downregulation of IL2, IL15, TGFβ1 and Myc responsive genes

Since we observed that the Y823F mutation diminishes c-Kit/D816V-mediated cell proliferation, survival and colony formation through weaker phosphorylation of Akt, Erk1/2 and STAT5, we hypothesized that this mutation might influence c-Kit-D816V-mediated gene expression. Therefore, we checked global gene expression using Mouse Gene 2.0 ST Array. Oncogenic c-Kit/D816V initiates aberrant expression of numerous proto-oncogenes and anti-apoptotic genes. Cells expressing c-Kit/D816V/Y823F displayed, compared to c-Kit/D816V

expressing cells, an up-regulation of pro-apoptotic genes, while expression of oncogenes and anti-apoptotic genes was suppressed (Fig. 6A, Table S1 and S2). Furthermore, gene set enrichment analysis (GSEA) suggests that deregulated genes (Fig. S2) display enrichment of several signaling pathways (Table S3) and oncogenic signatures (Table S4). For example, Myc (Fig. 6B), IL2 (Fig. 6C and 6E), IL15 (Fig. 6D) and TGFβ1 (Fig. 6F) pathway genes are downregulated in c-Kit/D816V/Y823F expressing cells. Surprisingly we also observed that genes that are downregulated under hypoxic conditions are also downregulated in c-Kit/D816V/Y823F expressing cells (Fig. 6G) Thus, we suggest that the Y823F mutation plays an opposing role to that of the oncogenic mutation c-Kit/D816V, which is partially mediated through transcriptional initiation of pro-apoptotic genes as well as suppression of oncogenes and anti-apoptotic genes probably by controlling STAT5 activation.

Y823F mutation causes accelerated degradation of c-Kit receptor as compared with c-Kit/D816V

To investigate the possible mechanism by which Y823F mutation exerts its growth inhibitory potential, we performed degradation assay on Ba/F3 cells transfected with c-Kit/D816V and c-Kit/D816V/Y823F. Cycloheximide treated cells were withdrawn at various time points, lysed and probed with c-Kit antibody. Degradation of receptor having Y823F mutation occurred faster as compared with c-Kit/D816V (Fig 7A). The half-life of c-Kit/D816V/Y823F was only 42 min. as compared with the half-life of c-Kit/D816V which was calculated as 72 min. (Fig. 7B).

Discussion

Gain of function mutations in tyrosine kinases are a major cause of progression towards transformation.[28] The two most commonly found regions of gain of function mutations in c-Kit are the juxtamembrane domain (JMD) and the kinase domain near to the activation loop.[29] Together these two regions, located in exon 11 and exon 17 respectively,

constitute the mutational hotspots in c-Kit. While about 85% of gastrointestinal stromal tumors result from activating mutation in the JMD, 90% of systemic mastocytosis carry a D816V mutation in the kinase domain. Normally, the JMD maintains the kinase in an auto-inhibitory state and the activation process involves two check points: the release of the JMD from the kinase domain that exposes the catalytic site to the substrate and, secondly, the activation loop coming to the DFG-in state. Exon 18 of the activation loop of c-Kit is located in the C-lobe of the kinase domain and is a less frequent site for mutation in tumors. To date rather little is known about the roles of the activation loop tyrosines in other receptors other than that they are in many cases involved the regulation of kinase activity. Previously, *in vitro* studies with recombinant wild-type c-Kit, have demonstrated that the corresponding site, Y823, is dispensable for kinase activity.[20] A study from Laine and colleagues suggests that several factors such as binding of a substrate, inhibitor or a point mutation within a protein can perturb the signal propagation and corresponding cellular communication.[3] They further demonstrated that the communication pathway between the JMD and the activation loop is disturbed by the D816V mutation. In the present study, we wanted to investigate the effect of the Y823F mutation in the activation loop on downstream signaling of c-Kit/D816V. We demonstrate that although there is no significant effect on the phosphorylation of c-Kit, the downstream signaling through the Ras/Erk and PI3K/Akt pathways is decreased. Upon ligand stimulation, activation of Akt, as well as of Erk and STAT5, was strongly reduced in cells expressing the c-Kit/D816V/Y823F mutant. In contrast, phosphorylation of p38 remained unchanged suggesting that the effect on downstream signaling is selective and that the oncogenic mutant of c-Kit partially transduces survival and proliferative signals through the Y823 residue.

We further show that cells expressing the c-Kit/D816V/Y823F mutant have almost a 50% reduction in cell survival and have a significantly lower cell proliferation compared to cells expressing c-Kit/D816V. However, the phenotypic outcome could be altered in presence of additional mutations due to a perturbed signaling pathway that maintains communication between distant locations in the c-Kit structure. A recent study demonstrated that the long distance communication between juxtamembrane and activation loop is disturbed by D816V mutation.[3] However, mutating the two major phosphorylation sites in the JMD (Y568, Y570) resulted in the D816V mutant in enhanced proliferation[30] suggesting that alterations in either positive or negative signaling pathways affect the transforming capacity of c-Kit/D816V. Y823 in the activation loop might be involved in binding and activation of signaling molecules whose activation is crucial for the expression of genes required for maintaining the transforming capacity of c-Kit/D816V oncogenic mutant. Our results are in concordance with other previous studies where murine Y821, analogous to c-Kit/Y823, was suggested to be important for cell proliferation and survival.[31] Tyrosine residues homologous to Y823 in other receptors, such as EGFR and PDGFR, have also been linked to cell survival and proliferation.[32-34] Given the fact that the effect on signaling is very selective, it is not unlikely that the phosphorylated Y823 forms a binding site for a signal transduction molecule that mediates the described effects. Although most signal transduction molecules have been demonstrated to bind to phosphorylated tyrosine residues outside the kinase domain, there are some exceptions. The corresponding tyrosine in the EGF receptor, Y845, was demonstrated to associate with the cytochrome c oxidase subunit II in a phosphorylation dependent manner.[32] In the oncogenic fusion protein NPM-ALK, phosphorylated Y343 in the activation loop binds to the protein tyrosine phosphatase SHP1 in a phosphorylation dependent manner. [35] Finally, the adapter protein Grb10 has been demonstrated to associate with the insulin receptor through tyrosine residues in the activation loop. [36] We have made attempts to identify

any possible interaction partners with phosphorylated Y823 by peptide affinity pull-down, but have so far not been able to identify any selective binding partner (data not shown).

Since the Y823F mutation affects cell survival and proliferation, we sought to determine its effect on the transforming capability of c-Kit/D816V. We show that cells expressing the c-Kit/D816V/Y823F mutant lose their ability to form colonies in semi-solid medium. This effect is opposite to the tyrosine mutants of JMD, which instead enhance the transformation potential of D816V.[30] We further show that the activation of STAT5 is significantly reduced in cells carrying the c-Kit/D816V/Y823F mutant. Under normal physiological conditions, STAT phosphorylation is tightly regulated but constitutive phosphorylation of STAT proteins has been linked to various human malignancies.[37, 38] Studies have shown that c-Kit/D816V can directly phosphorylate several different STAT proteins although in human mastocytoma cell lines only STAT5 is activated as a transcription factor.[27] Activated STAT5 has been directly associated with transformation of cells and enhances the aggressiveness of the tumor.[39, 40] The exact mechanism of STAT phosphorylation by c-Kit/D816V is not clear at the present time. As STAT5 directly links the receptor to its target genes, the decrease in cell proliferation of cells expressing c-Kit/D816V/Y823F mutation could be causally linked to the decrease in STAT5 activation and thereby downregulate genes that are linked to cell proliferation. The mechanism by which Y823 links to phosphorylation of STAT5 is unclear at present. It could be that phosphoylrated Y823 serves to recruit proteins involved in phosphorylation of STAT5, but this remains to be shown. To further verify the influence of the Y823F mutation on tumor formation *in vivo*, Ba/F3 cells expressing c-Kit/D816V or c-Kit/D816V/Y823F, respectively, were injected into mice. Introduction of the Y823F mutation led both to reduced weight and volume of the tumors. Finally, we show the differences in global gene expression of cells expressing Y823F mutation in comparison with c-Kit/D816V oncogenic mutant using microarrays. The genes

up-regulated in c-Kit/D816V/Y823F double mutant were mostly tumor suppressor genes. These include Schip1 (Schwannomin-interacting protein 1) and is associated with tumor suppression.[41] Annexin 3 is also described as both a tumor suppressor and a tumor activator protein depending on tumor and cell type.[42] Another upregulated gene is Ly75, lymphocyte antigen 75, which is linked to early metastasis in ovarian cancer.[43] Inpp5f , which is a polyphosphoinositide phosphatase described in cardiac hypertrophy[44], is also up-regulated in cells expressing the Y823F mutant. The down-regulated genes, however, belong mostly to anti-apoptotic pathways or survival pathways. Pim1 and Pim2 are associated with several hematological malignancies and other solid tumors.[45-47] Leukemogenesis through the related receptor mutant, FLT-3-ITD, has been related to increased expression of oncogenic PIM kinases.[48] Further, down-regulation of Ubiquitin specific proteases, Usp 7 and Usp 18 would enhance receptor degradation which is in concordance with lower cell survival with Y823F mutation.[49] Further, the downregulated genes Myc and Bcl2 are well-characterized oncoproteins.[50, 51] Thus, we conclude that tumor suppressor genes and pro-apoptotic genes are upregulated whereas genes involved in acute myeloid leukemia pathway in c-Kit/D816V/Y823F expressing cells are upregulated which is in concordance with its decreased tumorigenic potential.

We have previously shown that Y823F mutant exhibits accelerated degradation as compared with the wild type c-Kit receptor. [21] We further investigated if this also holds true for Y823F mutation in c-Kit receptor carrying D816V mutation. We observed that c-Kit/D816V/Y823F degrades much faster than c-Kit/D816V and has a half-life of only 42 min. as compared with 72 min. of c-Kit/D816V receptor. Previous studies have shown that activation loop tyrosines are crucial in maintaining structural stability of the receptor, a mutation of the only potential tyrosine in activation loop of c-Kit receptor therefore might de-stabilize it and cause accelerated and less sustained signaling through the receptor. [20, 21]

From previous studies, we know that activation loop tyrosine Y823 is not crucial for kinase activity, and its phosphorylation occurs late during the c-Kit activation process.[20] Our study demonstrates that mutation of Y823 causes aberrant downstream signaling including a reduction in the activation of transcription factor STAT5 which further significantly reduces transforming capacity of the oncogenic D816V mutant. Future studies will aim at identifying the proteins that are likely to bind to phosphorylated Y823 that mediates the effects seen. Given the importance of phosphorylation of Y823 for transformation, it will be of importance to understand the mechanisms by which this phosphorylation is regulated, and compounds that interfere with its phosphorylation could potentially be used as selective anti-tumor drugs.

Materials and Methods

Reagents and antibodies: Transfection reagents used were Lipofectamine 2000 **(**Life Technologies Europe BV, Stockholm, Sweden) and jetPEI (Polyplus transfections/BioNordika, Stockholm, Sweden). Human recombinant SCF and murine recombinant IL-3 (Interleukin-3) were obtained from ProSpec Tany Technogene (Rehovot, Israel). Rabbit polyclonal anti-c-Kit serum and anti-Cbl antibodies have been described elsewhere. [52] The phospho-tyrosine antibody 4G10 was bought from Millipore (Solna, Sweden). Antibodies against phospho-p38, p38 and Shc were from BD Transduction Laboratories. Anti-phospho-Akt antibody was purchased from Epitomics (Burlingame, CA). Polyclonal anti-Gab2, anti-Akt, anti-phospho-Erk, anti-Erk, anti-STAT5 and horseradish peroxidase-coupled secondary anti-goat antibodies were purchased from Santa Cruz Biotechnology (Dallas, TX). Secondary Horseradish peroxidase-coupled anti-mouse and anti-rabbit antibodies were from Life Technologies (Stockholm, Sweden).

Cell culture: Ba/F3 cells were cultured in RPMI 1640 medium supplemented with 10% heat-inactivated fetal bovine serum (FBS), 100 μg/ml streptomycin, 100 units/ml penicillin and 10 ng/ml recombinant murine interleukin-3 (IL-3). Dulbecco's modified Eagle's medium comprised 10% FBS, 100 μg/ml streptomycin and 100 units/ml penicillin and was used to culture COS-1 and EcoPack cells.

Expression constructs: pcDNA3-c-Kit/D816V, pMSCV-c-Kit/D816V constructs were described previously.[25] pcDNA3-c-Kit/D816V/Y823F and pMSCV-c-Kit/D816V/Y823F constructs were generated by site-directed mutagenesis using QuikChange mutagenesis XL kit (Agilent Technologies, Stockholm, Sweden). All plasmids were verified by sequencing.

Transient and stable transfection:

Transient transfection of COS1 cells was performed using JetPEI according to the manufacturer's instructions. Transfected cells were incubated for about 24 h before they were serum-starved overnight. Cells were stimulated with 100ng/ml SCF for indicated time periods. Cell lysis and immunoprecipitation was performed as described.[53] Stable transfections were performed as described.[25] Cells expressing c-Kit/D816V or c-Kit/D816V/Y823F were confirmed by flow cytometry.

Immunoprecipitation and Western blotting: Stimulated cells were washed 1x with cold PBS followed by cell lysis, immunoprecipitation and Western blotting as described elsewhere.[53] Immunodetection was performed by enhanced chemiluminescence using horseradish peroxidase substrate (Millipore Corporation, Billerica, MA, USA) and the signals were detected by a CCD camera (LAS-3000, Fujifilm, Tokyo, Japan). Signal intensities were quantified using Multi-Gauge software (Fujifilm).

Cell proliferation and survival assay: Ba/F3 cells were washed three times with RPMI-1640 medium and seeded in 24-well plates (70,000 cells/well). Cells were then incubated either with or without 100 ng/ml SCF or with 10 ng/ml IL-3 for 48 hours. Viable cells were counted using trypan blue exclusion method. Cell proliferation was also measured by staining the cells with Click-iT EdU Alexa 647 (Life Technologies Europe BV, Stockholm, Sweden) employing the manufacturer's protocol. Stained cells were then analyzed by flow cytometry (BD FACSCalibur). Apoptosis was measured using an Annexin-V, 7-Amino-actinomycin D (7-AAD) kit (BD Biosciences Pharmingen, Stockholm, Sweden), according to the manufacturer's instructions; double negative (Annexin-V^-/7-AAD^-) cells represent viable cells.

Degradation experiment: c-Kit/D816V and c-Kit/D816V/Y823F expressing Ba/F3 cells were incubated with 100 µg/ml of cycloheximide for 1h and samples were withdrawn at indicated time points. Total Cell lysates were subjected to SDS-PAGE followed by detection of c-Kit by Western blotting. Antibody against β-actin was used as a loading control. Half-life was calculated using Graph Pad prism software.

Colony formation assay: Ba/F3 cells expressing c-Kit/D816V and c-Kit/D816V/Y823F mutants were cultured in semi-solid methylcellulose medium (MethoCult M3231, Stem Cell Technologies, Grenoble, France) as described elsewhere.[25]

Animal experiments: Female athymic mice (NMRI-Nu/Nu strain) were used and housed in a controlled environment, and all procedures were approved by the regional ethics committee for animal research (approval no. M69/11). Six million cells in 100 µl Matrigel:PBS (2,3:1) were subcutaneously injected on the right flank. Mice (n=5 for each group) were monitored

daily, and tumors were excised, measured and weighed 5 days after injection. Tumor volume is calculated by (π x l x s^2)/6, where l=long side and s=short side.

Gene expression analysis

Ba/F3-c-Kit-D816V and Ba/F3-cKit-D816V-Y823F cells were serum- and cytokine- starved for 6 hours before extraction of total RNA using RNeasy Mini Kit (Qiagen, Sollentuna, Sweden). Quality of extracted RNA was checked with Bio-analyzer and then subjected to expression analysis using Affymetrix GeneChip® Mouse Gene 2.0 ST Array. Raw data were processed for RMA normalization followed by Significance Analysis of Microarrays (SAM) analysis. Additionally ANOVA analysis was performed. Gene enrichment in signaling pathways was done by Gene Set Enrichment Analysis software (GSEA- Broad Institute). The Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway dataset was used for GSEA analysis.

Conflict of interests

The authors declare no conflict of interest.

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612

613 **Figure Legends**

614 **Fig. 1**. Y823F mutation in the c-Kit/D816V oncogenic mutant does not affect phosphorylation
615 of c-Kit receptor but reduces cell proliferation.

616 (**A**) Ba/F3 cells stably transfected with c-Kit/D816V or c-Kit/D816V/Y823F plasmids,
617 respectively, were labeled with phycoerythrin-conjugated anti-c-Kit antibodies or an isotype
618 control to be analyzed by flow cytometry for cell surface expression. The *black peak* indicates
619 cells labeled with the isotype control, and the *gray peak* corresponds to the cells labeled with
620 anti-c-Kit antibody. (**B**) Ba/F3 cells expressing Ba/F3-c-Kit/D816V and Ba/F3-c-
621 Kit/D816V/Y823F were serum-starved for 4 h at 37°C. Alternatively, transient transfection
622 was performed in Cos1 cells following overnight starvation at 37°C. Following starvation
623 cells were stimulated with SCF for 5 min. Cell lysates were prepared, immunoprecipitated
624 (*IP*) with anti-c-Kit antibody and analyzed by Western blotting. Loss of phosphorylation in
625 Y823F mutant was verified by anti-pY823 antibody. Total receptor phosphorylation was
626 detected using phosphotyrosine *(pY)* antibody and c-Kit was used as a loading control. **(C)**
627 Quantification of total phosphorylation was performed by measuring signal intensities from
628 three independent experiments using Multi-Gauge software. GraphPad Prism was used to
629 calculate significance. *ns*, not significant. Error bars indicate SEM (**D**) Ba/F3-c-Kit/D816V
630 and Ba/F3-c-Kit/D816V/Y823F cells were grown for 48 h in the presence or absence of SCF
631 and with IL-3. To analyze proliferating cells, EdU was added, and cells were incubated for 2 h
632 at 37°C. Cells were fixed, labeled with Alexa Fluor 647 and analyzed by flow cytometry.

633 **Fig. 2.** The Y823F mutation in c-Kit/D816V negatively regulates select down-stream
634 signaling pathways

Ba/F3-c-Kit/D816V and Ba/F3-c-Kit/D816V/Y823F cells were serum-starved and treated with or without 100 ng/ml SCF. Total cell lysates were separated by SDS-PAGE, electrotransferred to Immobilon P membrane and probed with either phospho-Akt antibody or phospho-Erk1/2 or phospho-p-38 antibodies (**A**). Membranes were stripped and reprobed with respective non-phosphorylated total protein as loading controls. (**B**) Signal intensities from three independent experiments were quantified using Multi-Gauge software to calculate the difference in band intensities between the phosphorylated and unphosphorylated protein. GraphPad Prism was used to calculate significance. *ns*, not significant, **, $p < 0.01$, ***, $p < 0.001$.

Fig. 3. Cells expressing c-Kit/D816V/Y823F display decreased survival and proliferative capacity compared to cells expressing c-Kit/D816V

Ba/F3-c-Kit/D816V and Ba/F3-c-Kit/D816V/Y823F cells were grown for 48 h in the presence or absence of SCF and IL-3. (**A**). Viable cells were counted by trypan blue exclusion method ***(B)*** cells were also labeled with annexin V and 7-aminoactinomycin D and living cells were analyzed by flow cytometry. IL-3 was used as a positive control. Quantification of labeled cells was performed using FloJo software and results from three independent experiments were statistically analysed using GraphPad Prism, *ns*, not significant, ***p<0.01*, ***, $p < 0.001$.

Fig. 4. Introduction of the Y823F mutation in c-Kit/D816V leads to loss of transforming capability

Ba/F3 cells depleted from serum and cytokines were mixed with methylcellulose hematopoietic colony assay medium and incubated at 37 °C in a humidified atmosphere (**A**) c-Kit/D816V/Y823F mutant cells could not form colonies in semi-solid media whereas c-Kit/D816V oncogenic mutant retained its colony formation capability. (**B**) Stably transfected

c-Kit/D816V and c-Kit/D816V/Y823F cells were serum and cytokine starved for 4h at 37°C. Cell lysates were prepared, and endogenous STAT-5 was immunoprecipitated (*IP*) with STAT-5 antibody. Activation of STAT-5 was detected by Western blotting using pY antibody. Total STAT-5 was used as a loading control. (**C**) STAT-5 phosphorylation versus total STAT-5 was quantified using Multi-Gauge software from three independent experiments. GraphPad Prism was further used to calculate the significance. *ns*, not significant, ***, $p < 0.001$.

Fig. 5. Introduction of the Y823F mutation in c-Kit/D816V leads to a reduction in both tumor weight and volume in female athymic mice

Five athymic mice (NMRI-Nu/Nu strain) were subcutaneously injected with Ba/F3 cells expressing c-Kit/D816V and c-Kit/D816V/Y823F mutation. (**A**) Tumors carrying the c-Kit/D816V/Y823F mutant were much smaller in size and volume as compared with tumors developed from cells expressing c-Kit/D816V. Mouse 1 carrying the c-Kit/D816V/Y823F mutant was devoid of any tumor formation. (**B**, **C**) Tumors from 5 mice were excised, weighed and measured 5 days post infection. Statistical analysis was performed using GraphPad Prism, *, $p < 0.05$.

Fig. 6. Cells expressing the c-Kit/D816V/Y823F mutant display downregulated expression of proto-oncogenes and up-regulated expression of tumor suppressor genes compared to cells expressing c-Kit/D816V

Total RNA extracted from Ba/F3-c-Kit/D816V and Ba/F3-c-Kit/D816V/Y823F cells were subjected to microarray expression analysis using Affymetrix GeneChip® Mouse Gene 2.0 ST Array. (**A**) Differential gene expression was analyzed and presented using GraphPad

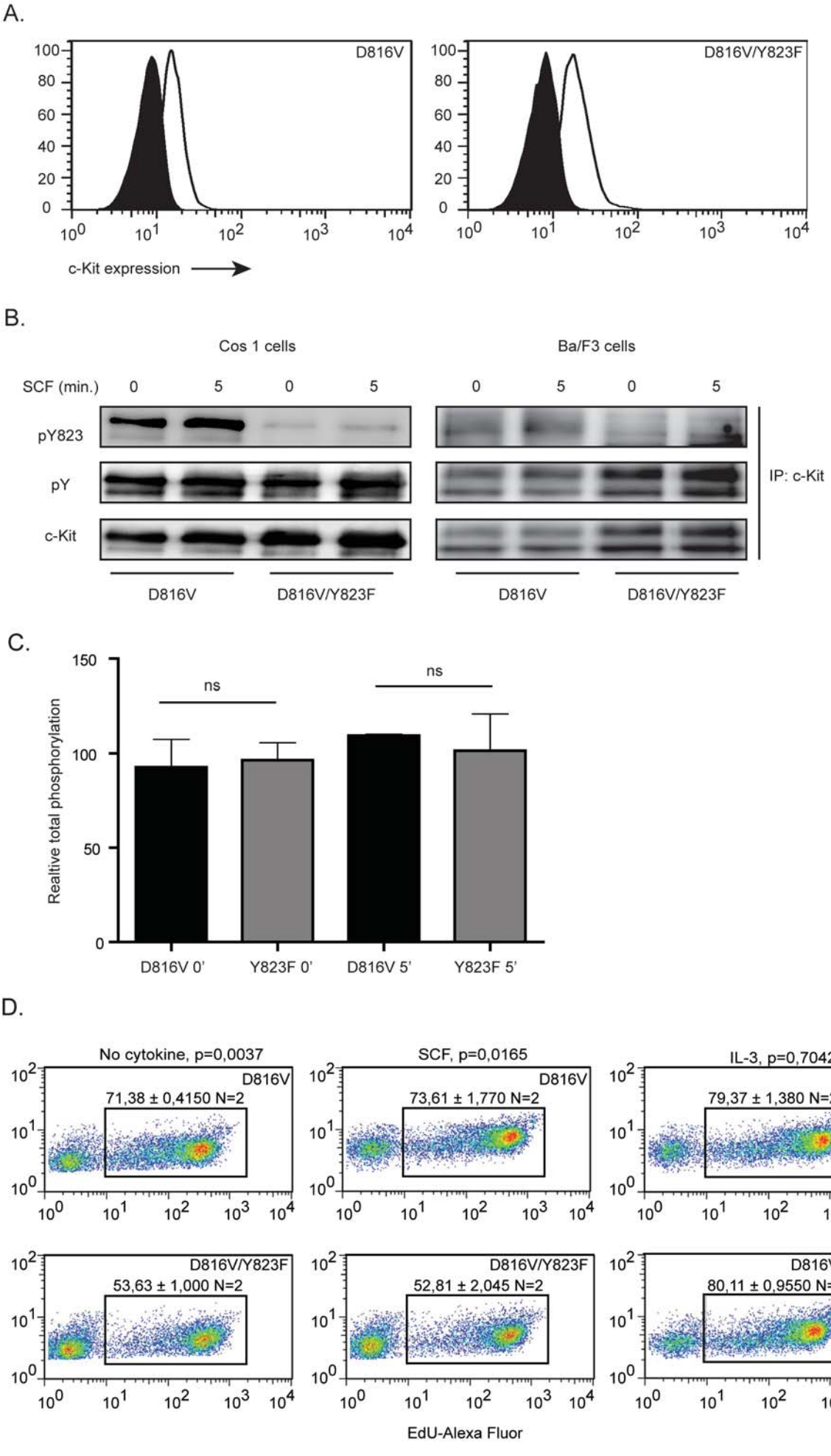
682 Prism. Gene set enrichment analysis shows enrichment in different oncogenic signatures (**B-**
683 **D**) and signaling pathways (**F-G**).

684

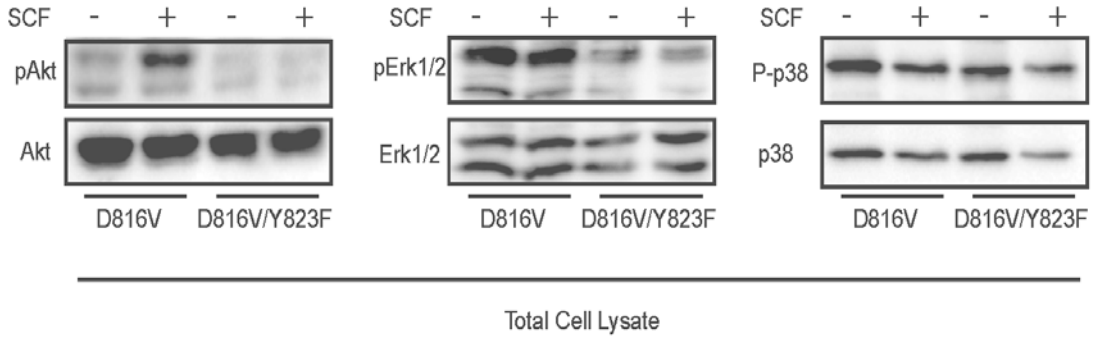
685 **Fig. 7.** The c-Kit/D816V/Y823F mutant has a higher degradation rate compared to c-
686 Kit/D816V

687 **(A)** Ba/F3 cells expressing c-Kit c-Kit/D816V and c-Kit/D816V/Y823F were treated with 100
688 μM of cycloheximide. Equal amount of cells were withdrawn at different time points
689 followed by lysis and western blotting analysis. **(B)** Quantification of total c-Kit was
690 performed by measuring signal intensities using Multi-Gauge software. GraphPad Prism was
691 used to calculate half-life.

Figure 1


A.
D816V
D816V/Y823F
c-Kit expression
B.
Cos 1 cells
Ba/F3 cells
SCF (min.)
pY823
pY
c-Kit
IP: c-Kit
D816V
D816V/Y823F
C.
Realtive total phosphorylation
ns
D816V 0'
Y823F 0'
D816V 5'
Y823F 5'
D.
No cytokine, p=0,0037
SCF, p=0,0165
IL-3, p=0,7042
71,38 ± 0,4150 N=2
73,61 ± 1,770 N=2
79,37 ± 1,380 N=2
53,63 ± 1,000 N=2
52,81 ± 2,045 N=2
80,11 ± 0,9550 N=2
EdU-Alexa Fluor

A.



Total Cell Lysate

B.

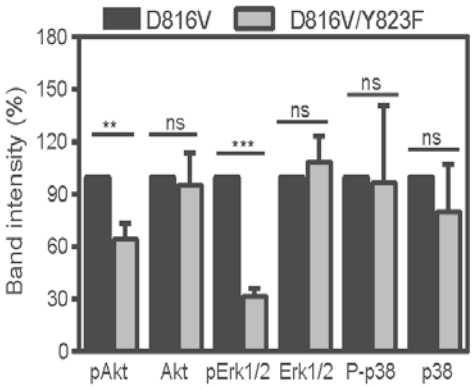
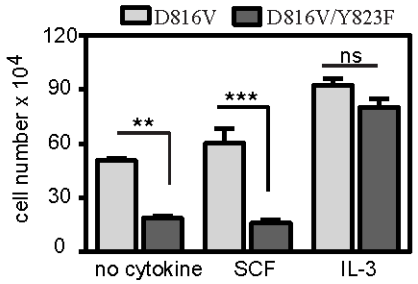


Figure 3

A.


D816V
D816V/Y823F
cell number x 10^4
120
90
60
30
0
**
***
ns
no cytokine
SCF
IL-3

B.

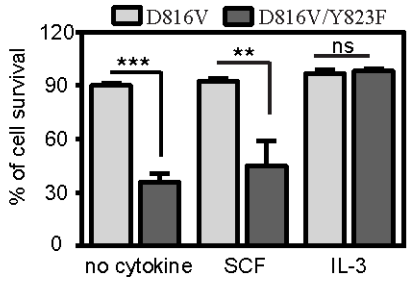

D816V
D816V/Y823F
% of cell survival
120
90
60
30
0
***
**
ns
no cytokine
SCF
IL-3

Figure 4

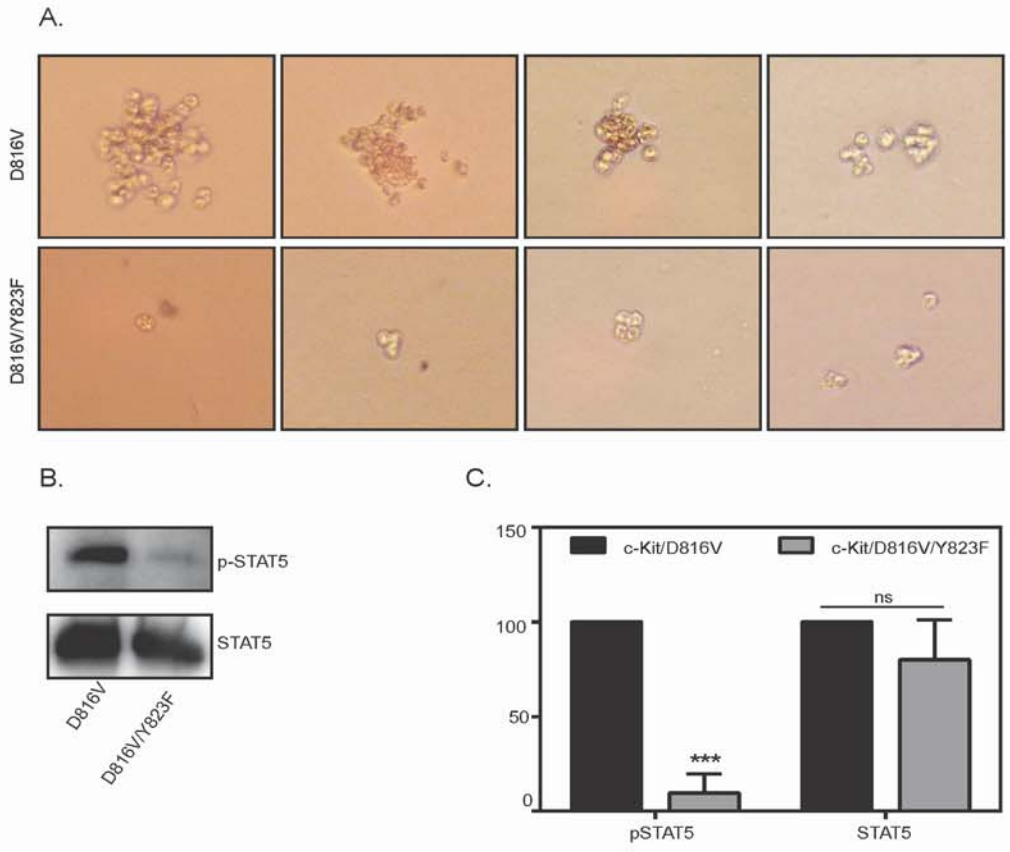
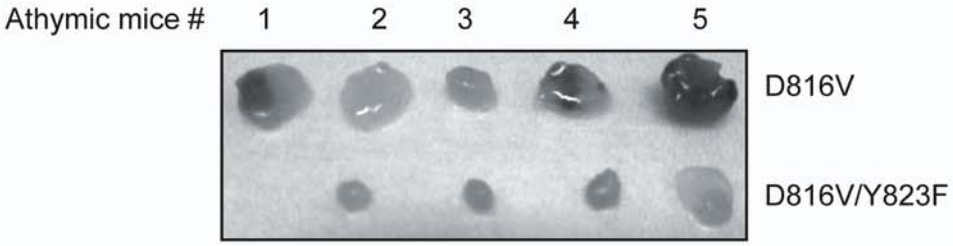
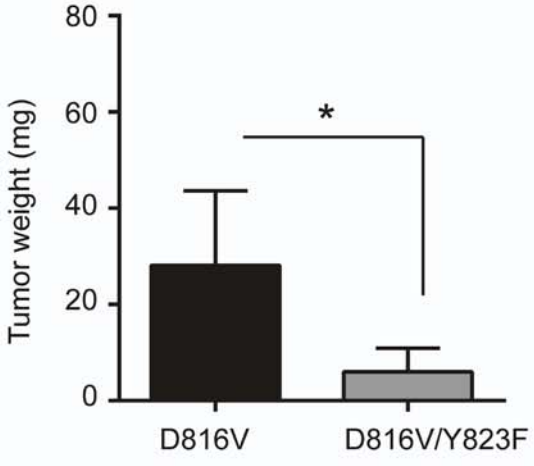

A.
D816V
D816V/Y823F
B.
p-STAT5
STAT5
D816V
D816V/Y823F
C.
150
100
50
0
c-Kit/D816V
c-Kit/D816V/Y823F
ns
***
pSTAT5
STAT5

Figure 5

A.


Athymic mice #
1
2
3
4
5
D816V
D816V/Y823F

B.


Tumor weight (mg)
80
60
40
20
0
*
D816V
D816V/Y823F

C.

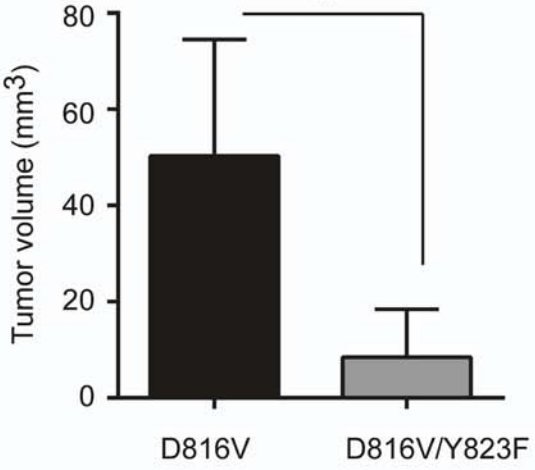

Tumor volume (mm3)
80
60
40
20
0
*
D816V
D816V/Y823F

Figure 6

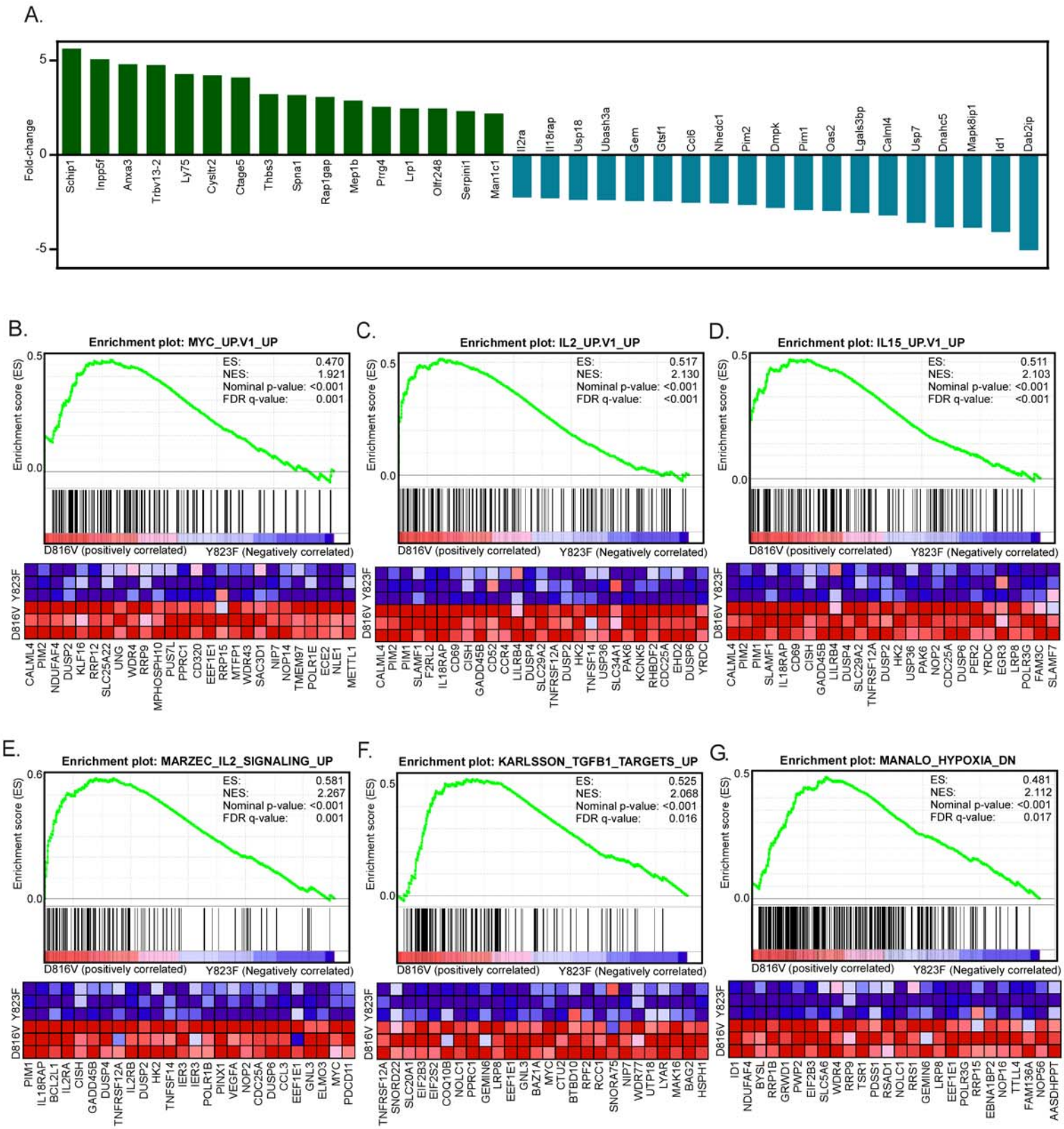
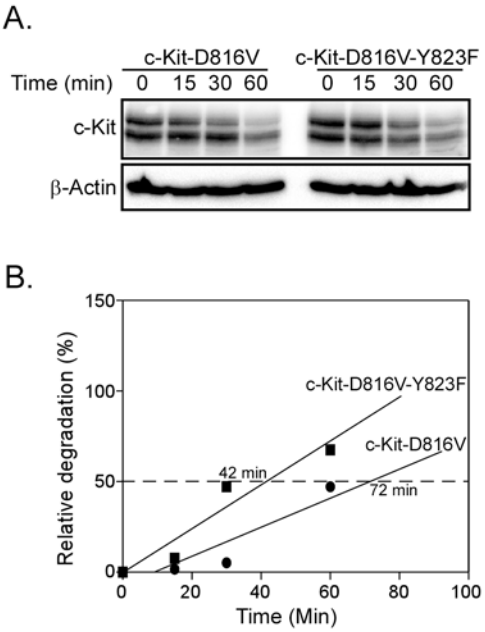

A.
Fold-change
5
0
-5
Schip1
Inpp5f
Anxa3
Trbv13-2
Ly75
Cystltr2
Ctage5
Thbs3
Spna1
Rap1gap
Mep1b
Prrg4
Lrp1
Olfr248
Serpini1
Man1c1
Il2ra
Il18rap
Usp18
Ubash3a
Gem
Gtsf1
Ccl6
Nhedc1
Pim2
Dmpk
Pim1
Oas2
Lgals3bp
Calml4
Usp7
Dnahc5
Mapk8ip1
Id1
Dab2ip
B.
Enrichment plot: MYC_UP.V1_UP
ES: 0.470
NES: 1.921
Nominal p-value: <0.001
FDR q-value: 0.001
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
CALML4 PIM2 NDUFAF4 DUSP2 KLF16 RRP12 SLC25A22 UNG WDR4 RRP9 MPHOSPH10 PUS7L PPRC1 CD320 EEF1E1 RRP15 MTFP1 WDR43 SAC3D1 NIP7 NOP14 TMEM97 POLR1E ECE2 NLE1 METTL1
C.
Enrichment plot: IL2_UP.V1_UP
ES: 0.517
NES: 2.130
Nominal p-value: <0.001
FDR q-value: <0.001
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
CALML4 PIM2 PIM1 SLAMF1 F2RL2 IL18RAP CD69 CISH GADD45B CD52 CCR4 LILRB4 DUSP4 SLC29A2 TNFRSF12A DUSP2 HK2 TNFSF14 USP36 SLC34A1 PAK6 KCNK5 RHBDF2 CDC25A EHD2 DUSP6 YRDC
D.
Enrichment plot: IL15_UP.V1_UP
ES: 0.511
NES: 2.103
Nominal p-value: <0.001
FDR q-value: <0.001
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
CALML4 PIM2 PIM1 SLAMF1 IL18RAP CD69 CISH GADD45B LILRB4 DUSP4 SLC29A2 TNFRSF12A DUSP2 HK2 USP36 PAK6 NOP2 CDC25A DUSP6 PER2 YRDC EGR3 LRP8 POLR3G FAM3C SLAMF7
E.
Enrichment plot: MARZEC_IL2_SIGNALING_UP
ES: 0.581
NES: 2.267
Nominal p-value: <0.001
FDR q-value: 0.001
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
PIM1 IL18RAP BCL2L1 IL2RA CISH GADD45B DUSP4 TNFRSF12A IL2RB DUSP2 HK2 TNFSF14 IER3 IER3 POLR1B PINX1 VEGFA NOP2 CDC25A DUSP6 CCL3 EEF1E1 GNL3 ELMO3 MYC PDCD11
F.
Enrichment plot: KARLSSON_TGFB1_TARGETS_UP
ES: 0.525
NES: 2.068
Nominal p-value: <0.001
FDR q-value: 0.016
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
TNFRSF12A SNORD22 SLC20A1 EIF2B3 EIF2S2 COQ10B NOLC1 PPRC1 GEMIN6 LRP8 EEF1E1 GNL3 BAZ1A MYC CTU2 BTBD10 RPF2 RCC1 SNORA75 NIP7 WDR77 UTP18 LYAR MAK16 BAG2 HSPH1
G.
Enrichment plot: MANALO_HYPOXIA_DN
ES: 0.481
NES: 2.112
Nominal p-value: <0.001
FDR q-value: 0.017
Enrichment score (ES)
D816V (positively correlated)
Y823F (Negatively correlated)
D816V Y823F
ID1 NDUFAF4 BYSL RRP1B GRWD1 PWP2 EIF2B3 SLC5A6 WDR4 RRP9 TSR1 PDSS1 RSAD1 NOLC1 RRS1 GEMIN6 LRP8 EEF1E1 POLR3G RRP15 EBNA1BP2 NOP16 TTLL4 FAM136A NOP56 AASDHPPT

Figure 7


A.
c-Kit-D816V
c-Kit-D816V-Y823F
Time (min)
0 15 30 60
0 15 30 60
c-Kit
β-Actin
B.
Relative degradation (%)
150
100
50
0
c-Kit-D816V-Y823F
c-Kit-D816V
42 min
72 min
0 20 40 60 80 100
Time (Min)

The activation loop tyrosine 823 is essential for the transforming capacity of the c-Kit oncogenic mutant D816V

Shruti Agarwal[1,2], Julhash U. Kazi[1,2], Sofie Mohlin[1,3], Sven Påhlman[1,3] and Lars Rönnstrand[1,2]*

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Supplementary Materials

List of Content

Table S1: Deregulated genes in Gene Level Differential Expression Analysis (page 2-3)

Transcript Cluster ID	Y842F Bi-weight Avg Signal (log2)	D816V Bi-weight Avg Signal (log2)	Fold Change (linear) (Y842F vs. D816V)	ANOVA p-value (Y842F vs. D816V)	FDR p-value (Y842F vs. D816V)	Gene Symbol
17329056	10.25	6.68	11.9	0.000043	0.052481	A930003A15Rik
17439464	9.75	7.48	4.81	0.000002	0.038575	Anxa3
17457694	11.27	9.02	4.76	0.000303	0.073878	Trbv13-2
17300093	10.07	8.16	3.75	0.000019	0.041445	
17457691	9.84	8.11	3.32	0.000676	0.095089	
17219698	8.72	7.06	3.17	0.000277	0.073878	Spna1
17300129	5.17	3.72	2.73	0.000088	0.056722	A630038E17Rik
17388999	8.73	7.38	2.56	0.000335	0.074132	Prrg4
17219758	6.09	4.79	2.46	0.013837	0.309414	Olfr248
17247332	8.85	7.56	2.44	0.002828	0.17058	
17398323	6.95	5.73	2.33	0.000164	0.069395	Serpini1
17257041	4.97	3.79	2.27	0.038709	0.458596	
17300127	6.95	5.79	2.23	0.018049	0.342776	A630038E17Rik
17431332	7.74	6.6	2.2	0.004529	0.204146	Man1c1
17257235	10.68	9.59	2.13	0.000008	0.038575	Itgb3
17209819	6.51	5.45	2.09	0.01696	0.335758	
17229767	8.95	7.9	2.07	0.004427	0.204146	Ly9
17208285	4.52	3.48	2.06	0.00457	0.204146	
17299070	8.02	7	2.03	0.009366	0.266433	
17204555	4.88	5.89	-2.01	0.046393	0.487494	
17494649	7.92	8.93	-2.01	0.00307	0.175627	Gm17757
17205869	4.88	5.89	-2.02	0.012128	0.291521	
17337706	6.25	7.27	-2.03	0.00063	0.093687	Rhag
17227780	6.09	7.11	-2.04	0.000284	0.073878	Rgs1
17255899	6.74	7.77	-2.04	0.005089	0.215159	B230217C12Rik
17289281	7.81	8.84	-2.04	0.000124	0.061747	F2rl2
17463338	7.97	9.01	-2.05	0.000019	0.041445	Fgf23
17205255	4.43	5.48	-2.06	0.020549	0.360463	
17205777	6.1	7.14	-2.06	0.044744	0.483015	
17206915	3.98	5.02	-2.06	0.038474	0.458212	
17209445	4.43	5.48	-2.06	0.020549	0.360463	
17209075	4.93	5.98	-2.08	0.040788	0.465726	
17514435	6.55	7.63	-2.12	0.000011	0.038575	Casp4
17538096	4.56	5.65	-2.13	0.001079	0.113315	Rnf128
17452115	4.11	5.22	-2.17	0.0016	0.134288	Oas1g
17210723	4.8	5.94	-2.2	0.030927	0.417657	

17200967	5.64	6.81	-2.26	0.007564	0.246037	
17206365	3.51	4.71	-2.3	0.026661	0.394659	
17212252	8.55	9.75	-2.3	0.000011	0.038575	Il18rap
17206865	4.69	5.94	-2.37	0.006686	0.237901	
17462437	8.1	9.35	-2.38	0.000046	0.052481	Usp18
17335798	5.42	6.68	-2.39	0.000881	0.105874	Ubash3a
17411840	7.23	8.51	-2.43	0.001038	0.111754	Gem
17417620	2.99	4.28	-2.43	0.007933	0.24998	
17322402	5.11	6.4	-2.44	0.000162	0.069155	Gtsf1
17291026	5.38	6.67	-2.46	0.008179	0.252357	Mir1983
17266960	7.19	8.53	-2.53	0.000969	0.109317	Ccl6
17402877	6.14	7.49	-2.56	0.00002	0.041445	Nhedc1
17533031	8.37	9.76	-2.63	0.000162	0.069155	Pim2
17201745	5.01	6.47	-2.76	0.040645	0.465156	
17201921	5.01	6.47	-2.76	0.040645	0.465156	
17335540	9.91	11.45	-2.91	0.000006	0.038575	Pim1
17452054	7.98	9.55	-2.95	0.000045	0.052481	Oas2
17523387	6.89	8.48	-3.02	0.00011	0.058997	Fam198a
17518238	6.27	7.94	-3.19	0.000254	0.073878	Calml4
17370040	6.21	8.08	-3.65	0.001812	0.142125	
17304005	5.79	7.67	-3.67	0.001136	0.115782	Gm10248
17377778	7.58	9.6	-4.07	0.000056	0.053626	Id1
17205693	3.54	5.63	-4.25	0.011424	0.286785	
17548804	4.56	8.03	-11.1	0.000036	0.052481	Gm9429

Table S2: Deregulated genes in Exon Level Differential Expression Analysis (Page 4-41)

Transcript Cluster ID	PSR/Junction ID	Y842F Bi-weight Avg Signal (log2)	D816V Bi-weight Avg Signal (log2)	Fold Change (linear) (Y842F vs. D816V)	ANOVA p-value (Y842F vs. D816V)	FDR p-value (Y842F vs. D816V)	Gene Symbol
17329056	17329062	10.28	6.2	16.88	0.000073	0.172949	A930003A15Rik
	17329057	10.35	6.5	14.41	0.000015	0.120576	
	17329058	10.14	6.41	13.24	0.000013	0.120576	
	17329061	10.01	7.75	4.8	0.000102	0.172949	
	17329059	9.38	7.21	4.49	0.000051	0.156362	
17285267	17285277	6.56	3.04	11.46	0.013177	0.486175	Lyst
	17285306	4.46	2.98	2.78	0.01008	0.457836	
17439464	17439471	9.55	6.45	8.54	0.000003	0.083716	Anxa3
	17439470	7.74	5.04	6.53	0.000093	0.172949	
	17439474	8.67	6.05	6.18	0.000205	0.209449	
	17439466	10.22	7.62	6.03	0.000022	0.12396	
	17439475	10.02	7.48	5.83	0.000018	0.123763	
	17439469	9.69	7.26	5.36	0.000096	0.172949	
	17439476	9.6	7.18	5.33	0.00013	0.178291	
	17439472	10.13	7.8	5.01	0.000518	0.250315	
	17439473	11.46	9.23	4.69	0.000003	0.083716	
	17439477	10.51	8.32	4.56	0.000122	0.176411	
	17439468	9.78	7.63	4.44	0.000037	0.140355	
	17439467	9.21	7.28	3.83	0.000003	0.083716	
	17439478	10.25	8.38	3.65	0.000083	0.172949	
	17439465	7.52	6.45	2.1	0.029392	0.580034	
17219698	17219728	7.01	4.05	7.81	0.003127	0.347723	Spna1
	17219744	10.22	7.3	7.6	0.001154	0.300915	
	17219748	7.61	4.76	7.21	0.018115	0.52116	
	17219727	9.52	6.81	6.57	0.004904	0.383406	
	17219746	7.84	5.15	6.48	0.018376	0.523316	
	17219716	8.31	5.86	5.46	0.012046	0.475819	
	17219732	10.55	8.11	5.42	0.00009	0.172949	
	17219745	8.57	6.21	5.16	0.003945	0.370001	
	17219706	8.12	5.81	4.97	0.000586	0.260419	
	17219709	10.85	8.54	4.97	0.000023	0.126083	
	17219711	8.9	6.61	4.86	0.008195	0.430989	
	17219738	10.53	8.27	4.81	0.001054	0.298219	

	17219749	7.14	4.9	4.73	0.0089	0.440672	
	17219734	7.51	5.32	4.56	0.020976	0.535216	
	17219701	8.09	5.9	4.53	0.026173	0.563773	
	17219739	9.04	6.97	4.21	0.002459	0.332021	
	17219721	7.46	5.42	4.12	0.006521	0.409658	
	17219715	8.09	6.24	3.6	0.007379	0.419719	
	17219741	8.29	6.51	3.42	0.005063	0.386255	
	17219702	10.18	8.44	3.35	0.000015	0.120576	
	17219699	6.97	5.34	3.08	0.015951	0.508065	
	17219723	7.78	6.19	3.01	0.005212	0.388645	
	17219729	8.24	6.81	2.69	0.001656	0.312252	
	17219713	10.42	9.05	2.59	0.000456	0.242049	
	17219718	8.19	6.89	2.47	0.032114	0.592249	
	17219712	8.91	7.61	2.46	0.0013	0.303953	
	17219719	9.5	8.24	2.4	0.000018	0.123763	
17415239	17415267	6.22	3.35	7.28	0.033501	0.596873	BC057079
	17415257	6.43	5.37	2.09	0.017165	0.515785	
17458020	17458027	5.77	2.92	7.18	0.047823	0.642471	Arhgef5
	17458026	6	4.95	2.06	0.045221	0.634775	
17225853	17225860	5.47	2.63	7.16	0.043765	0.630571	Slco6b1
17390637	17390662	5.68	2.87	6.97	0.026028	0.563499	Frmd5
17255999	17256017	5.33	2.6	6.63	0.02833	0.575032	Erbb2
17504780	17504793	5.66	3	6.33	0.003339	0.352125	Plekhg4
17300093	17300096	11.03	8.38	6.27	0.000033	0.140355	
	17300095	10.04	8.21	3.55	0.000085	0.172949	
	17300094	8.21	7.15	2.08	0.039256	0.61615	
17365883	17365890	7.07	4.43	6.27	0.008499	0.434989	Afap1l2
	17365884	8	5.68	4.99	0.015045	0.501471	
17309726	17309728	4.76	2.21	5.87	0.03775	0.611156	Nalcn
17483242	17483247	5.18	2.66	5.73	0.02482	0.557098	Mylpf
17522971	17522993	5.43	2.93	5.65	0.004713	0.380705	Vill
17398198	17398213	7.14	4.65	5.63	0.000249	0.219999	Schip1
17432058	17432059	5.14	2.66	5.59	0.034392	0.599041	Padi1
17213060	17213077	4.54	2.08	5.51	0.037875	0.611505	Aox4
17463268	17463273	5.5	3.06	5.41	0.002104	0.327223	Ano2
17526663	17526666	6.49	4.11	5.21	0.001642	0.312252	Fam55b
	17526665	6.36	4.82	2.91	0.016229	0.509535	
17398323	17398330	7.43	5.05	5.2	0.001387	0.304411	Serpini1
	17398331	8.21	6.2	4.03	0.023158	0.549834	
	17398333	8.08	6.25	3.55	0.00668	0.412981	

	17398329	9.16	7.78	2.6	0.003556	0.360132	
	17398326	7.03	5.98	2.06	0.004609	0.379032	
	17398332	8.53	7.5	2.05	0.046096	0.636498	
17469183	17469187	4.53	2.17	5.15	0.025527	0.560515	Magi1
17457694	17457696	11.29	8.94	5.1	0.000289	0.228356	Trbv13-2
	17457695	7.78	6.7	2.1	0.004452	0.377737	
17540743	17540744	4.23	1.88	5.09	0.000155	0.192643	Slx
17483740	17483763	4.89	2.55	5.08	0.000555	0.2555	Inpp5f
17398052	17398060	5.22	2.88	5.06	0.038673	0.61419	Kcnab1
	17398055	6.84	5.72	2.18	0.015554	0.505102	
17309935	17309958	5.05	2.73	4.97	0.024639	0.556717	Dab2
17308556	17308559	8.76	6.47	4.89	0.001641	0.312252	Cysltr2
	17308560	6.54	4.46	4.23	0.00052	0.250315	
	17308558	7.24	6.23	2.02	0.004279	0.373895	
17245923	17245953	6.86	4.6	4.8	0.001608	0.312252	Lrp1
	17245985	6.25	4.95	2.46	0.016182	0.509235	
	17245992	5.39	4.21	2.27	0.034862	0.600365	
17231431	17231432	4.64	2.39	4.74	0.007922	0.429365	1700052N19Rik
17265631	17265637	4.49	2.25	4.72	0.010771	0.46447	Slc13a5
17500108	17500129	6.03	3.8	4.72	0.022774	0.547044	Fgfr1
17215932	17215945	5.52	3.3	4.64	0.007736	0.427268	Sned1
17428289	17428299	5.92	3.74	4.54	0.006229	0.407681	Skint10
17437302	17437331	5.59	3.41	4.51	0.020911	0.534526	Slit2
17225630	17225632	4.53	2.39	4.42	0.00034	0.232026	Kif1a
17341106	17341114	4.3	2.16	4.42	0.007235	0.417938	Wdr27
17414802	17414825	5.25	3.12	4.39	0.045885	0.636157	Pappa
17489229	17489233	4.77	2.65	4.36	0.028555	0.575737	Etv2
17455691	17455695	4.8	2.69	4.29	0.001886	0.320582	C87414
17385574	17385588	5.84	3.74	4.28	0.001893	0.320822	Ly75
17406586	17406594	5.29	3.2	4.27	0.013078	0.484702	Ntrk1
17502860	17502866	5.79	3.7	4.27	0.048977	0.646539	Rnf150
17467040	17467056	4.96	2.89	4.19	0.007307	0.418563	Crhr2
17524775	17524781	6.1	4.05	4.16	0.040192	0.618932	Dock6
17275724	17275725	5.36	3.33	4.1	0.000718	0.274407	Ctage5
17388999	17389002	9.47	7.44	4.1	0.00019	0.207489	Prrg4
	17389003	9.98	8.06	3.78	0.000095	0.172949	
	17389005	9.24	7.45	3.46	0.000126	0.177397	
	17389000	7.88	6.49	2.63	0.016602	0.512613	
	17389001	8.56	7.38	2.27	0.003734	0.364426	
17234936	17234937	5.17	3.13	4.09	0.013459	0.488226	Hcn2

17406129	17406139	4.49	2.47	4.05	0.001181	0.300915	Tmem144
17457691	17457692	9.88	7.87	4.05	0.000011	0.11246	
	17457693	9.86	8.25	3.05	0.001715	0.315672	
17370705	17370710	5.02	3.01	4.04	0.036254	0.60583	Lypd6
17397990	17398001	5.15	3.14	4.03	0.01497	0.501053	Mme
17419902	17419912	4.48	2.49	3.97	0.044384	0.632348	Myom3
17395732	17395745	4.76	2.77	3.96	0.009736	0.454586	Kcnq2
17215298	17215299	4	2.02	3.94	0.044372	0.632348	Neu2
17498962	17498981	5.06	3.09	3.92	0.046598	0.638623	Col4a2
	17498973	6.64	5.51	2.18	0.028142	0.574219	
17212982	17213013	6.74	4.77	3.91	0.036351	0.606306	Aox1
17416967	17416977	4.73	2.79	3.86	0.024378	0.555229	Spata6
17414913	17414923	5.24	3.3	3.83	0.002904	0.342882	Frmd3
17456084	17456088	5.49	3.56	3.82	0.028224	0.574465	Foxp2
17545530	17545532	6.23	4.3	3.8	0.007992	0.430106	4930524N10Rik
17401144	17401158	6.17	4.24	3.79	0.005502	0.394386	Dennd2c
17321169	17321176	4.25	2.34	3.74	0.010571	0.463303	Asb8
17324259	17324270	4.79	2.89	3.72	0.01683	0.513912	Map3k13
	17324265	5.13	3.71	2.67	0.041933	0.624176	
17385099	17385241	7.73	5.83	3.72	0.002924	0.34303	Neb
	17385141	5.67	4.39	2.43	0.003162	0.348456	
	17385104	7.74	6.57	2.25	0.033261	0.595532	
	17385249	7.04	5.92	2.17	0.04449	0.632689	
17382249	17382263	5.87	3.98	3.7	0.003863	0.368391	Cacna1b
17385853	17385874	4.51	2.62	3.7	0.021306	0.537227	Grb14
17431332	17431338	7.45	5.56	3.7	0.011134	0.469752	Man1c1
	17431340	8.31	6.53	3.43	0.000965	0.294398	
	17431334	7.93	6.2	3.3	0.001076	0.298219	
	17431333	7.85	6.29	2.95	0.002635	0.335941	
	17431341	7.46	5.95	2.84	0.000502	0.250296	
	17431344	7.69	6.33	2.57	0.012736	0.482251	
17352779	17352808	7.48	5.6	3.68	0.031609	0.589933	Osbpl1a
17384355	17384373	4.95	3.07	3.68	0.034031	0.598003	Traf1
17347406	17347430	4.07	2.2	3.66	0.030184	0.584172	Prkd3
17467072	17467081	4.99	3.13	3.63	0.032741	0.594833	Pde1c
17214269	17214292	5.29	3.43	3.62	0.008178	0.430797	Plcd4
17360240	17360243	6.29	4.44	3.61	0.041253	0.622232	Ccdc147
17410435	17410436	6.07	4.22	3.6	0.021163	0.536179	Npnt
17257579	17257583	4.46	2.63	3.57	0.00815	0.430661	2310007L24Rik
17494370	17494379	5.06	3.22	3.57	0.012932	0.483312	Trim30b

17340050	17340077	9.52	7.69	3.56	0.002981	0.344223	Plekhh2
	17340060	8.17	6.63	2.92	0.026169	0.563773	
	17340075	9.98	8.64	2.53	0.000102	0.172949	
	17340080	9.87	8.56	2.47	0.000692	0.272959	
	17340074	6.71	5.47	2.37	0.000494	0.248367	
	17340064	9.55	8.32	2.34	0.000735	0.275011	
	17340063	9	7.81	2.28	0.011228	0.470646	
	17340072	8.91	7.75	2.24	0.002822	0.3417	
	17340079	10.01	8.89	2.17	0.001418	0.304411	
	17340068	9.2	8.11	2.13	0.000301	0.228356	
	17340071	8.62	7.53	2.13	0.002817	0.3417	
	17340056	10.63	9.58	2.07	0.002435	0.332021	
	17340057	10.89	9.84	2.07	0.002135	0.327666	
	17340070	9.83	8.79	2.06	0.000681	0.271459	
	17340058	8.98	7.95	2.03	0.007454	0.421706	
17382709	17382717	4.75	2.92	3.56	0.020967	0.535169	4921530D09Rik
17241053	17241065	4.55	2.73	3.53	0.011101	0.469215	Cdh23
17502470	17502483	6.48	4.66	3.53	0.018293	0.522725	Nwd1
17294828	17294855	6.28	4.46	3.51	0.020216	0.531883	Rasgrf2
17382432	17382437	5.26	3.45	3.51	0.011623	0.472957	Slc34a3
17462472	17462488	6.23	4.42	3.51	0.037864	0.611505	Slc6a12
17389161	17389192	4.67	2.87	3.5	0.003578	0.360273	Ano3
	17389182	5.96	4.57	2.63	0.047336	0.640632	
17247332	17247335	8.92	7.12	3.49	0.000292	0.228356	
17247332	17247334	7.63	6.53	2.14	0.005503	0.394386	
17428589	17428596	5.01	3.21	3.48	0.024006	0.554622	Tspan1
17215507	17215511	5.34	3.55	3.47	0.030893	0.5867	Trpm8
17376891	17376900	5.37	3.59	3.43	0.015995	0.508065	Sptlc3
17368260	17368276	5.95	4.18	3.42	0.045692	0.635886	Gpsm1
17285944	17285960	7.15	5.38	3.41	0.019324	0.527237	Cmah
	17285959	7.87	6.24	3.1	0.000267	0.224502	
	17285947	4.4	2.87	2.89	0.026171	0.563773	
	17285961	8.56	7.07	2.8	0.014038	0.493041	
	17285955	7.02	5.55	2.77	0.023801	0.553786	
17284065	17284102	5.7	3.94	3.39	0.006456	0.408602	Cdc42bpb
17306921	17306928	6.19	4.43	3.39	0.013361	0.48781	Cbln3
17486589	17486599	5.06	3.31	3.37	0.005693	0.397674	Slc27a5
17248896	17248905	4.81	3.07	3.35	0.043734	0.63057	Trim7
17452264	17452278	5.35	3.61	3.34	0.010735	0.464182	Acad10
17499412	17499435	5.69	3.95	3.34	0.006741	0.413237	Dlgap2

17364280	17364317	6.14	4.41	3.33	0.043277	0.62923	Myof
17469365	17469379	6.2	4.47	3.33	0.015693	0.505777	Frmd4b
	17469371	8.12	6.59	2.89	0.013687	0.490416	
17357981	17358000	5.9	4.17	3.32	0.035229	0.601741	Prune2
	17357996	6.45	4.84	3.06	0.00035	0.236218	
17216498	17216506	4.62	2.89	3.31	0.041144	0.622107	Cdh7
17445394	17445410	4.77	3.04	3.31	0.017439	0.517553	A330021E22Rik
17374488	17374496	6.23	4.51	3.29	0.023511	0.551167	Thbs1
	17374508	7.06	5.63	2.71	0.039816	0.617297	
17245798	17245818	5.9	4.19	3.27	0.013803	0.491488	Kif5a
17483870	17483874	6.42	4.71	3.27	0.021083	0.53578	Btbd16
17302429	17302468	3.73	2.04	3.24	0.040699	0.620592	Lmo7
17425533	17425549	5.76	4.06	3.24	0.025252	0.559029	Epb4.1l4b
17399347	17399350	7.03	5.34	3.23	0.000401	0.236218	Thbs3
	17399355	7.61	5.97	3.1	0.00544	0.393779	
17359368	17359383	5.28	3.59	3.22	0.043827	0.630699	Cc2d2b
17486692	17486694	5.94	4.26	3.21	0.027055	0.568527	Sult2a6
17264448	17264467	5.76	4.08	3.2	0.019008	0.52595	Arhgef15
17350203	17350208	4.64	2.96	3.19	0.033181	0.595231	Spink5
17334275	17334278	6.55	4.88	3.17	0.00922	0.445699	Caskin1
17350332	17350346	5.51	3.84	3.17	0.002109	0.32734	Kcnn2
	17350341	6.09	4.72	2.58	0.030753	0.585925	
17372197	17372219	5.92	4.26	3.17	0.000358	0.236218	Osbpl6
17231925	17231927	9.12	7.46	3.15	0.000619	0.263917	Mtap7
	17231931	6.59	4.98	3.07	0.003372	0.352871	
	17231929	7.6	6.06	2.91	0.000192	0.207506	
	17231932	7.34	5.84	2.83	0.007314	0.418615	
	17231940	7.03	5.98	2.08	0.001174	0.300915	
	17231941	6.53	5.5	2.05	0.001628	0.312252	
17361285	17361298	4.17	2.51	3.15	0.031585	0.589802	Syt12
17317127	17317132	5.51	3.86	3.14	0.013239	0.4864	Gm9920
17360602	17360623	5.11	3.46	3.14	0.040282	0.619185	Tdrd1
17503866	17503877	4.43	2.78	3.14	0.042301	0.625912	Slc6a2
17232394	17232406	6.31	4.66	3.13	0.004239	0.373895	Themis
	17232405	3.89	2.49	2.64	0.028652	0.57648	
	17232399	6.65	5.38	2.41	0.00094	0.292997	
17367686	17367689	4.7	3.07	3.1	0.019996	0.530179	Il1rn
17539303	17539343	5.83	4.2	3.1	0.024712	0.556918	Phka2
17291992	17291993	4.38	2.75	3.09	0.008178	0.430797	Ofcc1
17420316	17420326	5.73	4.1	3.08	0.000217	0.209449	Rap1gap

17229767	17229778	8.46	6.84	3.07	0.002017	0.32541	Ly9
	17229774	9.05	7.49	2.95	0.000946	0.293282	
	17229772	9.55	8.08	2.79	0.000324	0.228356	
	17229775	9.3	7.91	2.62	0.000783	0.276874	
	17229773	9.8	8.65	2.21	0.002487	0.332021	
	17229777	9.29	8.18	2.16	0.001122	0.300915	
	17229779	7.54	6.52	2.03	0.047851	0.642556	
17351963	17351971	4.95	3.33	3.07	0.045605	0.635768	Loxhd1
17228234	17228245	4.93	3.32	3.06	0.044148	0.631588	Npl
17531302	17531306	4.46	2.85	3.06	0.02509	0.558664	Fbxw13
17251222	17251243	3.86	2.25	3.05	0.019835	0.528659	Gas7
17313862	17313872	3.81	2.2	3.05	0.044796	0.633592	Ppara
17456627	17456673	6.01	4.4	3.04	0.010644	0.464161	Flnc
17486408	17486417	5.13	3.53	3.04	0.007858	0.428737	
17451512	17451513	5.74	4.14	3.03	0.002309	0.331553	Foxn4
17457703	17457705	7.57	5.99	3.01	0.000654	0.268431	
17354513	17354561	5.69	4.11	3	0.005304	0.391383	Fbn2
17219758	17219761	5.93	4.35	2.99	0.033063	0.595157	Olfr248
	17219760	7	5.8	2.29	0.028361	0.575051	
17380813	17380826	6.65	5.07	2.98	0.027766	0.572165	Col9a3
	17380823	7.33	6.17	2.23	0.026865	0.567318	
	17380825	5.84	4.71	2.19	0.007987	0.430106	
17244785	17244818	4.7	3.13	2.97	0.037643	0.610809	Otogl
17254071	17254078	4.14	2.58	2.96	0.021744	0.54006	Tmem132e
17428253	17428266	4.57	3	2.96	0.037618	0.610572	Slc5a9
17442765	17442768	4.81	3.25	2.95	0.044919	0.634268	Tmem132c
17297923	17297949	6.47	4.92	2.93	0.000415	0.236218	
17445089	17445125	6.31	4.76	2.93	0.034882	0.600365	Fry
	17445151	9.42	8.21	2.31	0.018321	0.523097	
17213953	17213960	5.44	3.9	2.91	0.004014	0.370001	Spag16
17432173	17432182	4.84	3.31	2.89	0.024587	0.556349	Clcnkb
17278209	17278216	5.76	4.23	2.88	0.044548	0.632927	Ppp4r4
17310368	17310378	5.55	4.02	2.88	0.011855	0.474616	Adamts12
17348860	17348865	3.92	2.39	2.88	0.000847	0.280074	Mep1b
17398430	17398440	5.22	3.7	2.86	0.029366	0.579929	Ctso
17478889	17478897	5.16	3.64	2.86	0.046432	0.637889	Apba2
17221878	17221899	3.7	2.19	2.85	0.021332	0.537279	Bai3
17369286	17369287	4.63	3.12	2.85	0.002634	0.335941	Prrx2
17419305	17419313	8.92	7.4	2.85	0.034867	0.600365	Matn1
	17419310	8.38	6.94	2.72	0.010274	0.461128	

	17419315	8.33	7.13	2.3	0.037134	0.609144	
	17419308	8.36	7.31	2.06	0.000715	0.274407	
17284808	17284821	3.96	2.46	2.83	0.008803	0.439491	Abcb5
17456900	17456911	4.86	3.36	2.83	0.048827	0.646267	Cpa5
17348003	17348005	5.31	3.81	2.82	0.016365	0.510921	Fshr
17303548	17303549	4.25	2.76	2.81	0.033738	0.597096	Gm281
17317015	17317025	6.03	4.55	2.81	0.013485	0.488316	Ext1
17344757	17344761	4.4	2.91	2.81	0.011985	0.475304	H2-M1
17398825	17398847	5.49	3.99	2.81	0.033901	0.597478	Insrr
17477930	17477934	5.8	4.31	2.81	0.006371	0.40803	Rasip1
17535488	17535491	6.65	5.16	2.81	0.016041	0.508065	Xlr5b
17318326	17318331	5.29	3.81	2.8	0.037321	0.60973	BC024139
17253215	17253224	5.28	3.81	2.78	0.022416	0.544942	Slc6a4
17286641	17286652	5.66	4.19	2.78	0.020431	0.532756	Dsp
17297391	17297394	5.81	4.33	2.78	0.032675	0.594712	Nid2
17409343	17409351	8.4	6.92	2.78	0.002114	0.327587	5330417C22Rik
	17409346	9.02	7.8	2.33	0.019648	0.528401	
	17409350	7.17	6.06	2.15	0.028052	0.573657	
17283516	17283525	4.85	3.39	2.76	0.010999	0.468698	Asb2
17303474	17303486	4.22	2.76	2.76	0.02801	0.573149	Fhit
17325979	17325983	9.06	7.59	2.76	0.002664	0.337316	Gcet2
	17325987	7.72	6.33	2.62	0.00146	0.304693	
	17325984	8.98	7.93	2.07	0.002924	0.34303	
17473580	17473588	7.27	5.81	2.76	0.026281	0.56467	Zfp667
17314317	17314365	4.75	3.29	2.74	0.007148	0.415964	Muc19
	17314350	4.25	3.13	2.17	0.044227	0.63193	
17249611	17249615	4.86	3.41	2.73	0.003914	0.369493	P4ha2
17300129	17300130	5.17	3.72	2.73	0.000088	0.172949	A630038E17Rik
17300127	17300128	6.95	5.79	2.23	0.018049	0.521032	
17367390	17367417	5.3	3.85	2.73	0.045179	0.634659	Etl4
17375327	17375336	6.01	4.56	2.73	0.01548	0.504439	Casc4
17433699	17433709	5.72	4.27	2.73	0.000459	0.242049	Plch2
17228293	17228338	5.14	3.69	2.72	0.001107	0.300371	Cacna1e
17416061	17416075	5.29	3.85	2.72	0.04938	0.647669	Sgip1
17416196	17416206	5.9	4.45	2.72	0.033821	0.597167	C8b
17279239	17279266	4.06	2.63	2.7	0.03176	0.590644	Tdrd9
17364452	17364460	3.8	2.36	2.7	0.048916	0.646403	Cyp2c54
17294860	17294861	6.16	4.74	2.69	0.047242	0.640306	Msh3
17521327	17521349	5.42	3.99	2.69	0.011169	0.470088	Cacna2d2
17257235	17257250	8.68	7.26	2.68	0.002213	0.329812	Itgb3

	17257244	10.69	9.39	2.47	0.000033	0.140355	
	17257253	10.19	8.88	2.47	0.002007	0.325313	
	17257245	10.65	9.37	2.42	0.001084	0.298364	
	17257246	10.18	8.95	2.35	0.000373	0.236218	
	17257252	9.39	8.18	2.31	0.002615	0.335731	
	17257248	9.5	8.31	2.29	0.005929	0.402147	
	17257251	10.84	9.65	2.29	0.000007	0.102636	
	17257240	11.69	10.52	2.25	0.000432	0.240307	
	17257241	10.77	9.67	2.15	0.000035	0.140355	
	17257249	11.59	10.52	2.09	0.000234	0.215045	
	17257243	11.65	10.6	2.07	0.000059	0.163294	
	17257239	11.76	10.73	2.04	0.000054	0.163294	
	17257238	11.86	10.85	2.01	0.000024	0.126083	
17504222	17504223	4.49	3.07	2.68	0.008485	0.434919	Ccdc135
17389339	17389376	5.01	3.6	2.66	0.021769	0.540182	Ryr3
	17389393	4.4	3.33	2.09	0.006834	0.413439	
17441726	17441753	5.66	4.24	2.66	0.011304	0.471732	Rasal1
17475385	17475390	4.59	3.18	2.66	0.015545	0.505102	Cyp2b9
17284919	17284921	5.37	3.96	2.65	0.008861	0.440403	Akr1c14
17470890	17470916	5.04	3.64	2.65	0.039878	0.617558	Usp5
17282828	17282835	5.41	4.01	2.64	0.045013	0.634333	4933437F05Rik
17480813	17480821	4.51	3.11	2.63	0.029995	0.583242	Stard10
17378905	17378917	6.52	5.13	2.62	0.000579	0.259981	Arhgap40
17221122	17221136	6.39	5	2.61	0.011949	0.475239	Sntg1
17275890	17275899	5.72	4.34	2.61	0.040935	0.621145	Klhdc1
17277978	17277992	5.25	3.87	2.61	0.016607	0.512613	Catsperb
17292759	17292762	5.73	4.35	2.61	0.007681	0.42571	Sncb
17439669	17439674	5.62	4.23	2.61	0.042628	0.627665	Arhgap24
17231100	17231105	5.25	3.88	2.6	0.002128	0.327587	Traf5
17257405	17257430	4.89	3.51	2.6	0.049776	0.648566	Tanc2
17358466	17358476	3.41	2.03	2.6	0.042264	0.625834	Slc1a1
17371201	17371211	5.52	4.14	2.6	0.000395	0.236218	Gca
17447404	17447409	4.23	2.85	2.6	0.00263	0.335936	Sorcs2
17478301	17478306	6.61	5.23	2.6	0.003502	0.359645	Nav2
	17478303	5.94	4.69	2.38	0.028215	0.574465	
	17478320	4.62	3.56	2.09	0.011635	0.472965	
17519438	17519439	5.39	4	2.6	0.041527	0.622405	Myo5c
17239919	17239929	5.3	3.94	2.58	0.036652	0.607107	Lama2
17264676	17264750	5.35	3.99	2.58	0.00657	0.410737	Dnahc2
	17264686	7.21	5.89	2.49	0.013126	0.485278	

17321202	17321204	7.28	5.92	2.57	0.038541	0.613779	Zfp641
17411575	17411579	4.47	3.11	2.57	0.049654	0.648457	Fam110b
17476143	17476157	4.91	3.55	2.57	0.028392	0.575138	
17446688	17446722	5.08	3.72	2.56	0.01513	0.502229	Otof
17456414	17456427	5.92	4.57	2.56	0.003123	0.347723	Asb15
17266928	17266944	3.97	2.62	2.55	0.035003	0.600653	Gm11435
17330264	17330266	9.1	7.75	2.55	0.000155	0.192643	Fbxo40
	17330265	9.38	8.14	2.36	0.001041	0.298219	
17430256	17430267	6.91	5.55	2.55	0.017165	0.515785	Zscan20
17455386	17455394	6.56	5.21	2.55	0.003762	0.365165	Slc46a3
17501234	17501236	3.69	2.34	2.55	0.016958	0.514861	Glra3
17516752	17516760	4.94	3.59	2.55	0.026126	0.563758	BC049352
17531405	17531408	5.28	3.93	2.55	0.006338	0.40803	Fbxw15
17419090	17419095	7.33	5.99	2.53	0.026226	0.564154	1700003M07Rik
17343088	17343105	5.52	4.19	2.52	0.013047	0.484609	Mdga1
17350982	17350994	7.23	5.9	2.52	0.002161	0.327872	Cd74
17456506	17456507	9.93	8.6	2.52	0.007054	0.415432	Snd1
17491285	17491309	6.14	4.81	2.52	0.038081	0.612144	Ptpn5
	17491303	7.22	6.1	2.17	0.017624	0.518834	
17496757	17496760	5.92	4.59	2.52	0.015435	0.504083	Ctf2
17371221	17371223	5.19	3.86	2.51	0.021159	0.536176	Scn2a1
17374137	17374141	6.06	4.73	2.51	0.023752	0.553199	Slc5a12
17386725	17386746	4.45	3.12	2.51	0.044299	0.632175	Pde11a
17511310	17511312	4.06	2.74	2.51	0.01421	0.494017	Zfp791
17519649	17519651	8.25	6.92	2.51	0.031458	0.5889	Gsta4
	17519652	10.88	9.69	2.28	0.000412	0.236218	
17519738	17519759	6.03	4.7	2.51	0.040366	0.619366	Cd109
17285414	17285429	6.45	5.13	2.5	0.03272	0.594806	Gli3
17304658	17304678	4.1	2.78	2.5	0.022871	0.547985	Dnahc1
17448174	17448185	6.87	5.55	2.5	0.00259	0.335505	Arap2
17448415	17448416	8.06	6.73	2.5	0.017947	0.520713	Apbb2
	17448423	8.89	7.79	2.15	0.001202	0.300915	
17464950	17464951	5.03	3.71	2.5	0.009902	0.455716	Tfec
17512121	17512122	3.78	2.46	2.5	0.02087	0.534257	Cdh8
17245539	17245549	3.94	2.63	2.49	0.008899	0.440672	Srgap1
17252574	17252581	7.58	6.26	2.49	0.0154	0.503732	Itgae
	17252578	6.16	5.11	2.07	0.002732	0.339202	
17451223	17451233	6.36	5.04	2.49	0.039405	0.616746	Sez6l
17212442	17212443	5.12	3.81	2.48	0.011219	0.470646	Gulp1
17347139	17347152	6.02	4.71	2.48	0.012094	0.476306	Galnt14

17348320	17348343	5.28	3.97	2.48	0.041	0.621306	Greb1l
17375701	17375714	5.61	4.3	2.48	0.010772	0.46447	Slc27a2
17385405	17385421	6.18	4.87	2.48	0.034867	0.600365	Cytip
17385879	17385881	3.47	2.16	2.48	0.029204	0.579285	Cobll1
17439388	17439455	7.22	5.91	2.48	0.001703	0.314859	Fras1
	17439432	7.25	5.97	2.44	0.022521	0.545506	
17512361	17512371	6.7	5.39	2.48	0.012296	0.478083	Exoc3l
17339729	17339761	3.52	2.22	2.47	0.033173	0.595231	Ltbp1
17415863	17415887	5.68	4.37	2.47	0.01154	0.472682	Cachd1
17436907	17436910	3.97	2.67	2.47	0.010671	0.464161	Afap1
17336338	17336357	6	4.7	2.46	0.026549	0.565769	Col11a2
17238762	17238781	4.84	3.54	2.45	0.040133	0.618904	Syne1
17249461	17249465	5.03	3.74	2.45	0.010212	0.460656	Fstl4
17433977	17434010	7.32	6.03	2.45	0.033885	0.597449	Agrn
17531856	17531865	4.58	3.29	2.45	0.048968	0.646475	4921528I07Rik
17232235	17232243	4.5	3.21	2.44	0.00456	0.378259	Ctgf
17238111	17238120	4.16	2.87	2.44	0.024491	0.555626	Myo1a
17449129	17449141	3.72	2.43	2.44	0.015172	0.502348	Epha5
17475231	17475239	5.21	3.92	2.44	0.004719	0.380705	Tmem145
17290913	17290916	4.52	3.24	2.43	0.011721	0.47313	Gpx5
17319913	17319950	5.39	4.11	2.43	0.011816	0.473914	Efcab6
17362753	17362754	6.35	5.06	2.43	0.033326	0.596031	Cd5
17383373	17383376	6.09	4.81	2.43	0.005737	0.398755	1700007K13Rik
	17383374	7.44	6.35	2.13	0.011321	0.471866	
17521716	17521718	3.93	2.65	2.43	0.018685	0.524587	BC048562
17267420	17267422	9.59	8.32	2.42	0.002753	0.340831	Ypel2
17295017	17295019	4.75	3.48	2.42	0.00812	0.430524	Bhmt2
17464886	17464892	5.05	3.78	2.42	0.000938	0.292766	Vwde
17291915	17291930	6.4	5.13	2.41	0.024541	0.556059	Cage1
17303339	17303344	4.5	3.23	2.41	0.018685	0.524587	
17333107	17333114	4.57	3.29	2.41	0.044271	0.631986	T2
17363107	17363124	6.54	5.27	2.41	0.048807	0.646204	U05342
17396439	17396450	5.96	4.68	2.41	0.031997	0.59137	Tnik
17422337	17422358	5.92	4.66	2.41	0.019838	0.528659	Megf6
17462244	17462255	6.53	5.26	2.41	0.003868	0.368391	Cacna2d4
17485019	17485023	6.56	5.29	2.41	0.027829	0.572422	Muc2
17529417	17529441	4.56	3.29	2.41	0.004718	0.380705	Snap91
17389510	17389520	7.01	5.74	2.4	0.049142	0.646787	Actc1
17497076	17497085	8.7	7.44	2.4	0.004711	0.380705	Chst15
	17497078	7.62	6.48	2.21	0.00189	0.320582	

	17497077	8.84	7.77	2.1	0.008072	0.430459	
	17497086	9.53	8.47	2.09	0.016606	0.512613	
	17497083	8.85	7.84	2.01	0.015162	0.502348	
17319625	17319632	6.55	5.29	2.39	0.011245	0.470668	Cyp2d22
17436558	17436559	4.89	3.63	2.39	0.045459	0.635465	LOC100862066
17439138	17439146	5.19	3.93	2.39	0.027818	0.572422	Shroom3
17467608	17467614	6.09	4.84	2.39	0.005603	0.396536	Rmnd5a
17542450	17542455	5.22	3.97	2.39	0.025337	0.559391	Arhgap4
17274394	17274395	5.14	3.89	2.38	0.001049	0.298219	Gm10330
17298267	17298270	5.75	4.5	2.38	0.016624	0.51283	Itih4
17230408	17230422	9.59	8.35	2.37	0.005213	0.388645	Adck3
	17230417	10.66	9.5	2.23	0.001598	0.312252	
	17230413	10.55	9.43	2.17	0.002437	0.332021	
	17230421	10.1	9.08	2.03	0.001377	0.304411	
17255877	17255889	6.1	4.85	2.37	0.045673	0.635768	Lasp1
17480048	17480053	4.69	3.44	2.37	0.010827	0.465777	Me3
17480205	17480210	5.38	4.14	2.37	0.028493	0.57553	Rab30
17539271	17539300	4.73	3.48	2.37	0.005915	0.401873	Gpr64
17239817	17239838	3.67	2.43	2.36	0.006504	0.409371	Enpp3
17419068	17419077	4.12	2.88	2.36	0.0148	0.499041	Spocd1
17436761	17436770	5.24	4	2.36	0.018265	0.522542	Rgs12
17504811	17504824	7.05	5.81	2.36	0.049352	0.647542	Lrrc36
17536353	17536357	6.08	4.84	2.36	0.002212	0.329812	Zc3h12b
17270919	17270928	4.08	2.84	2.35	0.027562	0.570765	Tex2
17280356	17280364	5.19	3.96	2.35	0.02216	0.543177	Dcdc2c
17383254	17383280	8.37	7.14	2.35	0.042114	0.624917	Sardh
17481541	17481547	5.14	3.91	2.35	0.001546	0.310409	Syt9
17512511	17512526	4.65	3.42	2.35	0.000921	0.28961	Ranbp10
17290016	17290024	4.69	3.46	2.34	0.020281	0.53214	BC067074
17406221	17406230	6.24	5.01	2.34	0.035248	0.601741	Gucy1a3
17253376	17253394	6.34	5.12	2.33	0.005051	0.386255	Sez6
17299119	17299126	4.42	3.2	2.33	0.009723	0.454586	
17396765	17396782	3.89	2.67	2.33	0.005421	0.393508	Usp13
17314260	17314315	6.24	5.02	2.32	0.019313	0.527237	Lrrk2
17317056	17317081	6.76	5.55	2.32	0.004146	0.372623	Enpp2
17326032	17326050	5.12	3.9	2.32	0.000277	0.228356	Morc1
17334730	17334744	5.79	4.57	2.32	0.015255	0.502923	Mslnl
17347114	17347138	6.52	5.3	2.32	0.030633	0.585504	Capn13
17359344	17359359	5.06	3.85	2.32	0.044155	0.631614	Entpd1
17389216	17389224	4.25	3.03	2.32	0.00749	0.422431	Gm15130

17498467	17498480	5.63	4.41	2.32	0.037029	0.608464	Ano1
17412730	17412737	3.45	2.24	2.31	0.026134	0.563758	Aco1
17243693	17243696	5.66	4.46	2.3	0.02874	0.57692	Bpifc
	17243710	6.93	5.78	2.22	0.013691	0.490416	
	17243701	6.35	5.27	2.11	0.001197	0.300915	
17251454	17251480	8.66	7.46	2.3	0.040203	0.618932	1500010J02Rik
17376229	17376245	4.41	3.21	2.3	0.014249	0.494516	Tmc2
17521428	17521432	6.42	5.22	2.3	0.020145	0.531378	Hyal1
17297059	17297069	4.81	3.62	2.29	0.001268	0.30367	Abhd6
17301582	17301583	5.76	4.56	2.29	0.022409	0.544818	Nefl
17306532	17306547	7.01	5.82	2.29	0.003077	0.347338	Myh6
17428441	17428453	5.71	4.51	2.29	0.00786	0.428737	Cyp4x1
	17428449	8.22	7.21	2.01	0.033532	0.596873	
17431811	17431816	6.66	5.46	2.29	0.005759	0.399028	Pla2g2f
17488492	17488497	5.7	4.5	2.29	0.022595	0.545647	Nccrp1
17493074	17493078	5.89	4.7	2.29	0.006977	0.415432	Vmn2r70
17268647	17268648	5.05	3.86	2.28	0.004693	0.380705	Fbxo47
17272346	17272366	5.68	4.49	2.28	0.043717	0.63057	Rnf157
17360406	17360423	6.86	5.68	2.28	0.003187	0.349034	Pdcd4
17445898	17445916	4.13	2.94	2.28	0.045193	0.634666	Slc26a5
17458191	17458208	6.63	5.45	2.28	0.046322	0.637478	Sspo
17490673	17490694	6.27	5.08	2.28	0.024776	0.55693	Ccdc155
17229417	17229419	4.25	3.07	2.27	0.004418	0.376479	Pbx1
17257038	17257041	4.97	3.79	2.27	0.038709	0.61419	Ccdc103
17273526	17273528	6.54	5.36	2.27	0.029471	0.580675	Rab40b
17308965	17308993	7.28	6.1	2.27	0.029666	0.581489	Diap3
17317555	17317561	6.05	4.87	2.27	0.021894	0.540696	Oc90
17360863	17360867	5.2	4.02	2.27	0.014836	0.499525	E330013P04Rik
17384374	17384387	4.58	3.39	2.27	0.017613	0.518834	Hc
17405047	17405049	4.56	3.37	2.27	0.026939	0.567808	2610316D01Rik
17435737	17435743	6.34	5.16	2.27	0.006377	0.40803	Fam59b
17478044	17478054	6.15	4.97	2.27	0.035102	0.601258	Tmem143
17536463	17536476	4.76	3.58	2.27	0.01384	0.491603	Stard8
17212724	17212746	10.5	9.32	2.26	0.001799	0.318021	Stat4
	17212743	10.23	9.08	2.22	0.000436	0.240307	
	17212729	9.15	8.01	2.2	2.29E-07	0.030873	
	17212733	8.44	7.31	2.19	0.002323	0.331749	
	17212735	9.88	8.76	2.17	0.000267	0.224502	
	17212739	9.55	8.46	2.14	0.011019	0.468698	
	17212744	9.92	8.83	2.13	0.000875	0.282584	

	17212734	10.39	9.38	2.02	0.000157	0.192827	
	17212736	8.81	7.8	2.01	0.00234	0.332021	
	17212737	9.96	8.95	2.01	0.004554	0.378259	
	17212745	11.05	10.04	2.01	0.00658	0.410879	
17253431	17253439	5.62	4.44	2.26	0.032543	0.594148	Flot2
17326405	17326419	5.93	4.75	2.26	0.022707	0.546292	Dcbld2
17370145	17370175	6.65	5.47	2.26	0.042807	0.628265	Cep110
17377177	17377195	5.65	4.47	2.26	0.01251	0.480471	Rin2
17314164	17314170	6.21	5.04	2.25	0.021857	0.540564	Mapk8ip2
17362616	17362622	6.27	5.1	2.25	0.042458	0.626741	Gm98
17454450	17454499	6.72	5.55	2.25	0.009452	0.449781	Ints1
17531999	17532011	4.49	3.32	2.25	0.025022	0.558201	Rbms3
17337770	17337788	5.07	3.91	2.24	0.003735	0.364426	Gpr116
17418767	17418836	4.84	3.67	2.24	0.009943	0.456043	Csmd2
17437674	17437677	8.03	6.87	2.24	0.012787	0.482623	Klf3
17449288	17449300	5.03	3.87	2.24	0.001625	0.312252	Tmprss11bnl
17456918	17456919	5.54	4.38	2.24	0.019526	0.528071	Cpa1
17485943	17485946	3.79	2.63	2.24	0.029054	0.578719	Shisa7
17521934	17521939	5.69	4.53	2.24	0.009697	0.454586	Celsr3
17227266	17227267	4.96	3.8	2.23	0.011987	0.475304	Elf3
17329403	17329421	6.14	4.98	2.23	0.007306	0.418563	Masp1
17471850	17471854	4.5	3.34	2.23	0.021227	0.536718	Styk1
17362831	17362838	6.06	4.91	2.22	0.011091	0.469215	Ccdc86
17366511	17366517	6.16	5.01	2.22	0.000851	0.280074	Phyh
17425301	17425346	8.58	7.43	2.22	0.037118	0.609116	Abca1
	17425313	10.37	9.28	2.13	0.019034	0.52595	
	17425303	9.74	8.71	2.05	0.004259	0.373895	
	17425335	10.18	9.16	2.03	0.016533	0.512335	
17221375	17221389	7.86	6.72	2.21	0.011253	0.470712	Eya1
17258964	17258976	6.79	5.65	2.21	0.026726	0.566416	Ccdc40
17382822	17382831	6.56	5.42	2.21	0.032844	0.594945	Nacc2
17482634	17482652	4.89	3.74	2.21	0.03913	0.615799	Otoa
17501633	17501639	4.28	3.14	2.21	0.04815	0.643745	Lpl
17522958	17522964	5.33	4.19	2.21	0.006727	0.413237	Ctdspl
17218449	17218450	5.24	4.1	2.2	0.044496	0.632694	Angptl1
17239787	17239803	4.97	3.83	2.2	0.04634	0.637593	Enpp1
17435855	17435859	6.93	5.79	2.2	0.005469	0.394254	Mapre3
17443353	17443359	4.87	3.73	2.2	0.043165	0.629025	Zp3
17467410	17467412	5.22	4.08	2.2	0.045306	0.634854	
17221817	17221848	5.28	4.15	2.19	0.023857	0.553786	Col19a1

17228624	17228631	5.62	4.49	2.19	0.0225	0.545497	Rasal2
17267815	17267817	6.32	5.19	2.19	0.018773	0.525151	Wfikkn2
17320337	17320369	6.82	5.69	2.19	0.026371	0.565264	Plxnb2
17348202	17348203	5.37	4.24	2.19	0.042482	0.626741	Zeb1
17528800	17528830	4.79	3.66	2.19	0.035595	0.602835	Unc13c
17214184	17214194	5.33	4.21	2.18	0.040851	0.621043	Gm216
17272626	17272648	6.17	5.05	2.18	0.040732	0.620733	Dnahc17
17286122	17286124	4.85	3.73	2.18	0.020527	0.53333	Prl3d3
17387542	17387557	4.72	3.6	2.18	0.007385	0.419755	P2rx3
17242006	17242024	6.95	5.84	2.17	0.020297	0.532145	Slc5a4b
17391259	17391268	6.38	5.26	2.17	0.032848	0.594945	Fahd2a
17400386	17400390	3.87	2.75	2.17	0.00903	0.442841	Hormad1
17434524	17434528	5.69	4.58	2.17	0.046099	0.636498	Abcb1a
17458486	17458500	5.76	4.64	2.17	0.017664	0.518834	Stk31
17473639	17473640	5.63	4.52	2.17	0.021982	0.541274	Usp29
17220059	17220097	3.94	2.83	2.16	0.032631	0.594712	Cdc42bpa
17248621	17248630	4.18	3.06	2.16	0.034858	0.600365	Ccnjl
17354411	17354424	5.5	4.39	2.16	0.047964	0.643183	Zfp608
17388177	17388182	6.33	5.22	2.16	0.023067	0.549315	Nr1h3
17413221	17413246	5.18	4.07	2.16	0.040273	0.619185	Unc13b
17415469	17415486	5.89	4.79	2.16	0.035806	0.604222	Tek
17457709	17457710	6.39	5.28	2.16	0.035007	0.600653	
17513092	17513099	7.15	6.04	2.16	0.004733	0.380967	Fa2h
17516621	17516622	6.37	5.26	2.16	0.040615	0.620305	Bcl9l
17234347	17234360	5.43	4.32	2.15	0.001627	0.312252	Upb1
17264053	17264067	6.1	4.99	2.15	0.037245	0.609344	Zfp287
17265062	17265066	6.76	5.66	2.15	0.021572	0.538814	2810408A11Rik
17268661	17268676	7.31	6.2	2.15	0.016038	0.508065	Plxdc1
17300097	17300099	5.19	4.08	2.15	0.001972	0.324676	
17331802	17331808	4.78	3.67	2.15	0.00758	0.42395	Grik1
17376728	17376749	5.93	4.82	2.15	0.016695	0.513336	Plcb4
17403043	17403046	5.46	4.35	2.15	0.02849	0.57553	Rg9mtd2
17403363	17403422	6.31	5.21	2.15	0.004896	0.383364	Col24a1
17430288	17430298	6.81	5.71	2.15	0.025327	0.559367	Adc
17230484	17230494	5.82	4.72	2.14	0.004932	0.383428	Ephx1
17243252	17243261	7.07	5.97	2.14	0.008653	0.437263	Tjp3
	17243271	10.75	9.74	2.01	0.001412	0.304411	
17324883	17324887	5.24	4.14	2.14	0.012631	0.481388	Muc4
17325159	17325188	8.05	6.95	2.14	0.017723	0.519149	Mylk
17411751	17411759	10.63	9.53	2.14	0.000297	0.228356	Trp53inp1

	17411755	9.33	8.29	2.05	0.00193	0.322256	
17455882	17455893	4.59	3.49	2.14	0.031545	0.589538	Ppp1r9a
17474809	17474818	3.57	2.47	2.14	0.02944	0.580592	Nlrp4e
17545121	17545131	5.75	4.65	2.14	0.025422	0.560054	Dcx
17216527	17216549	4.49	3.4	2.13	0.041561	0.622472	Cntnap5a
17339395	17339396	5.1	4	2.13	0.047915	0.642907	Myom1
17344881	17344890	5.98	4.89	2.13	0.014471	0.495666	Olfr112
17354299	17354324	3.77	2.68	2.13	0.02925	0.579523	Sema6a
17369911	17369922	10.17	9.08	2.13	0.004555	0.378259	Ak1
	17369923	10.07	9.01	2.08	0.01044	0.461456	
17402438	17402452	6.21	5.12	2.13	0.013414	0.48781	Camk2d
17463126	17463139	8.6	7.52	2.13	0.026525	0.565769	Iffo1
17482310	17482321	6.57	5.48	2.13	0.016239	0.509535	Acsm3
17485910	17485921	6.36	5.26	2.13	0.040069	0.618417	Fam71e2
17544078	17544080	4.37	3.28	2.13	0.008124	0.430524	Itm2a
17221148	17221153	7.5	6.42	2.12	0.020085	0.531051	2610203C22Rik
17229198	17229208	8.34	7.26	2.12	0.00433	0.37494	Tbx19
17236919	17236920	4.91	3.83	2.12	0.00936	0.448486	Gm4301
17236931	17236932	4.91	3.83	2.12	0.00936	0.448486	
17244567	17244569	4.91	3.83	2.12	0.00936	0.448486	
17244705	17244709	5.56	4.48	2.12	0.019785	0.528467	Acss3
17264208	17264267	4.99	3.9	2.12	0.02659	0.565769	Dnahc9
17435455	17435459	4.28	3.19	2.12	0.010331	0.461143	2900005J15Rik
17439687	17439706	5.31	4.22	2.12	0.045862	0.636147	Ptpn13
17441768	17441773	5.22	4.14	2.12	0.000595	0.261909	Oas1f
17469289	17469296	5.61	4.53	2.12	0.047984	0.643183	Eogt
	17469303	6.43	5.39	2.06	0.039533	0.616746	
17473018	17473046	4.68	3.6	2.12	0.031835	0.591041	Caprin2
17218701	17218705	7.52	6.45	2.11	0.017597	0.518834	Tnfsf4
17242959	17242965	7	5.93	2.11	0.005163	0.388258	Atp8b3
17245223	17245229	9.5	8.43	2.11	0.001119	0.300915	Lyz2
17273460	17273468	5.5	4.42	2.11	0.016732	0.513753	Sectm1a
17304049	17304063	6.04	4.96	2.11	0.032153	0.592282	Dlg5
17332974	17332984	8.01	6.93	2.11	0.007781	0.427678	Rps6ka2
17345422	17345445	6.9	5.82	2.11	0.023194	0.549907	Cul9
17371873	17371886	6.73	5.65	2.11	0.048208	0.644063	Rapgef4
17525746	17525767	6.49	5.41	2.11	0.020519	0.533294	AW551984
17219662	17219664	3.79	2.72	2.1	0.031994	0.59137	Pyhin1
17242842	17242849	9.62	8.55	2.1	0.007925	0.429368	Gamt
	17242848	9.87	8.82	2.06	0.002143	0.327698	

	17242847	9.58	8.56	2.03	0.002384	0.332021	
17375997	17376015	4.82	3.76	2.1	0.026911	0.567443	Mertk
17386569	17386577	6.86	5.79	2.1	0.002144	0.327698	Chn1
17397695	17397702	7.06	6	2.1	0.004895	0.383364	Sohlh2
17432835	17432852	6.2	5.13	2.1	0.000252	0.219999	Plod1
17449251	17449261	5.86	4.79	2.1	0.013531	0.488635	Tmprss11a
17518342	17518365	7.34	6.27	2.1	0.014859	0.499677	Megf11
17306968	17306973	9.38	8.32	2.09	0.000382	0.236218	Mcpt8
	17306970	9.02	8.01	2.01	0.000458	0.242049	
17416162	17416169	5.96	4.9	2.09	0.016356	0.510777	Dab1
17520983	17520993	7	5.94	2.09	0.035819	0.604291	Nphp3
17209819	17209819	6.51	5.45	2.09	0.01696	0.514861	
17298041	17298044	6.36	5.3	2.08	0.029565	0.581103	Arhgef3
17301468	17301474	3.51	2.45	2.08	0.037926	0.611544	Chrna2
17416926	17416944	4.15	3.1	2.08	0.028232	0.574465	Agbl4
17434585	17434588	4.48	3.42	2.08	0.005002	0.385697	Abcb4
17229348	17229353	5.94	4.89	2.07	0.043298	0.629254	Gm4846
17277101	17277120	5.44	4.39	2.07	0.035056	0.600886	Papln
17299135	17299140	5.36	4.31	2.07	0.025625	0.560937	
17308388	17308391	5.72	4.67	2.07	0.021481	0.538197	Sftpc
17353806	17353838	5.33	4.29	2.07	0.049644	0.648451	Diap1
17365511	17365550	6.99	5.95	2.07	0.010847	0.465777	Col17a1
17418732	17418735	3.68	2.63	2.07	0.04048	0.619863	Dlgap3
17248426	17248446	5.36	4.32	2.06	0.022712	0.546292	Slit3
17260668	17260671	9.48	8.43	2.06	0.002363	0.332021	Grb10
17268137	17268165	6.23	5.18	2.06	0.029736	0.58211	Itga3
17276192	17276213	3.36	2.32	2.06	0.007933	0.429534	Lrrc9
	17276196	3.33	2.3	2.04	0.017279	0.516744	
17299401	17299413	5.3	4.26	2.06	0.031297	0.588316	Peli2
17339357	17339379	5.47	4.43	2.06	0.022239	0.543689	Dlgap1
17378808	17378814	6.47	5.43	2.06	0.037228	0.60926	Bpi
17409963	17409964	4.95	3.91	2.06	0.034539	0.599347	Fnbp1l
17437727	17437745	8.2	7.16	2.06	0.015526	0.504954	Wdr19
17505124	17505137	6.58	5.54	2.06	0.047487	0.641222	Cdh3
17208285	17208285	4.52	3.48	2.06	0.00457	0.378259	
17230345	17230363	7.09	6.05	2.05	0.018989	0.52595	Ahctf1
17283096	17283099	5.97	4.93	2.05	0.030572	0.585093	Galc
17293635	17293641	6.25	5.21	2.05	0.025277	0.559286	Hsd17b3
17400773	17400775	5.18	4.14	2.05	0.041543	0.622461	Fmo5
17407049	17407057	6.17	5.13	2.05	0.040729	0.620717	Dcst1

17481556	17481573	3.31	2.28	2.05	0.048063	0.643435	Ppfibp2
17490721	17490735	9.25	8.21	2.05	0.040498	0.61988	Trpm4
17211867	17211871	4.9	3.87	2.04	0.014265	0.494516	Zap70
17291031	17291048	3.52	2.48	2.04	0.034337	0.598949	Prss16
17353108	17353117	7.61	6.58	2.04	0.031889	0.591345	Zscan30
17397297	17397317	7.3	6.27	2.04	0.024974	0.557897	3110057O12Rik
17417146	17417158	6.48	5.45	2.04	0.012179	0.477027	Pdzk1ip1
17448693	17448699	8.28	7.25	2.04	0.000803	0.278637	Txk
17456440	17456445	4.95	3.92	2.04	0.029369	0.579929	Hyal4
17474016	17474021	4.31	3.28	2.04	0.024372	0.555229	Zfp541
17224379	17224384	5.64	4.62	2.03	0.031403	0.588708	Fev
17240502	17240507	4.77	3.75	2.03	0.01053	0.462697	Armc2
17271632	17271650	3.41	2.39	2.03	0.044837	0.633938	Sdk2
17286973	17286983	7.64	6.62	2.03	0.035481	0.602418	Gmpr
17325787	17325804	7.56	6.54	2.03	0.049623	0.648424	Spice1
17355646	17355651	3.42	2.4	2.03	0.041691	0.623131	Ctdp1
17467430	17467432	4.41	3.38	2.03	0.042706	0.627963	Igkv4-72
17507184	17507185	5.58	4.56	2.03	0.006872	0.414182	Cd209d
17522876	17522883	5.34	4.32	2.03	0.017469	0.517852	Eomes
17279640	17279646	3.25	2.23	2.02	0.03976	0.616924	Ptprn2
17430487	17430501	5.37	4.35	2.02	0.036146	0.605356	Txlna
17440826	17440864	7.55	6.54	2.02	0.008413	0.434246	Acacb
17496015	17496023	5.28	4.27	2.02	0.009002	0.442543	Zkscan2
17510856	17510858	8.5	7.49	2.02	0.008498	0.434989	Il15
17518512	17518525	5.09	4.07	2.02	0.044275	0.631986	Cilp
17521485	17521502	7.37	6.35	2.02	0.029463	0.580675	Mst1r
17241181	17241189	6.34	5.33	2.01	0.04941	0.647833	Adamts14
17317717	17317721	8.59	7.59	2.01	0.029624	0.581341	Fam135b
17338545	17338559	6.91	5.9	2.01	0.017875	0.520713	Kcnh8
17391734	17391749	7.91	6.9	2.01	0.004545	0.378259	4930402H24Rik
17414512	17414515	4.06	3.05	2.01	0.042968	0.62841	Mup-ps12
17443154	17443156	7.67	6.66	2.01	0.009854	0.455449	Abhd11
17494848	17494860	3.27	2.26	2.01	0.048103	0.643584	Stk33
17520962	17520967	9.9	8.9	2.01	0.041622	0.622782	5830418P13Rik
17523705	17523728	4.62	3.62	2.01	0.019295	0.527066	Gria4
17533177	17533180	4.02	3.01	2.01	0.024558	0.556199	Gm5751
17219407	17219415	4.33	5.34	-2.01	0.026528	0.565769	Slamf1
	17219414	4.25	5.33	-2.11	0.019601	0.528188	
	17219416	5.46	6.71	-2.37	0.041955	0.624206	
	17219412	5.2	6.53	-2.51	0.019543	0.528085	

	17219411	5.16	6.58	-2.67	0.002957	0.343514	
17236990	17236991	2.47	3.47	-2.01	0.042025	0.624516	1700017N19Rik
17261289	17261325	4.28	5.28	-2.01	0.043504	0.630183	Eml6
17356924	17356943	6.49	7.49	-2.01	0.006181	0.406576	Nrxn2
17429383	17429385	4.51	5.51	-2.01	0.042904	0.62841	Ccdc30
17446220	17446223	4.65	5.65	-2.01	0.026077	0.563611	Asb10
17494649	17494650	7.92	8.93	-2.01	0.00307	0.347338	Gm17757
17500367	17500374	3.12	4.13	-2.01	0.038344	0.612985	Gm1698
17546797	17546800	2.06	3.07	-2.01	0.012462	0.480278	Uty
17204555	17204555	4.88	5.89	-2.01	0.046393	0.637723	
17272895	17272901	6.99	8.01	-2.02	0.018311	0.523043	Eif4a3
17294086	17294088	5.26	6.28	-2.02	0.047083	0.639994	Adcy2
17316754	17316761	10.22	11.23	-2.02	0.000233	0.215045	Lrp12
	17316756	9.39	10.51	-2.17	0.000008	0.102636	
	17316757	10.11	11.32	-2.31	0.000218	0.209476	
17331876	17331879	3.33	4.34	-2.02	0.039545	0.616746	Krtap8-2
17335742	17335747	6.29	7.31	-2.02	0.014431	0.495623	Umodl1
17344309	17344311	7.86	8.87	-2.02	0.004611	0.379126	Tnf
	17344310	7.42	8.5	-2.12	0.00078	0.276874	
	17344313	8.51	9.67	-2.23	0.002071	0.327223	
17366123	17366137	6.08	7.1	-2.02	0.005157	0.388227	Sfxn4
17388901	17388928	7.34	8.36	-2.02	0.033372	0.596138	D430041D05Rik
17392311	17392314	3.05	4.07	-2.02	0.046546	0.638516	C630020P19Rik
17419097	17419105	6.79	7.81	-2.02	0.045404	0.635252	Bai2
17421895	17421899	4.85	5.86	-2.02	0.049915	0.649154	Slc2a7
17459870	17459883	4.86	5.87	-2.02	0.020747	0.533681	Loxl3
	17459887	5.79	6.9	-2.17	0.005988	0.403082	
17461205	17461213	3.43	4.45	-2.02	0.020781	0.533732	Chl1
17500605	17500609	3.92	4.94	-2.02	0.022608	0.545703	6430573F11Rik
	17500617	5.85	6.96	-2.16	0.005133	0.387634	
17508224	17508228	8.2	9.21	-2.02	0.012857	0.482669	Adam3
17205869	17205869	4.88	5.89	-2.02	0.012128	0.476306	
17216792	17216802	7.07	8.09	-2.03	0.004666	0.380159	Ccnt2
17226302	17226310	4.54	5.56	-2.03	0.007132	0.41565	Dbi
17243493	17243499	4.64	5.66	-2.03	0.019078	0.526155	Glt8d2
17279190	17279197	7.15	8.17	-2.03	0.011155	0.470088	Trmt61a
	17279195	8.43	9.5	-2.1	0.002493	0.332185	
	17279193	8.4	9.48	-2.11	0.001879	0.320456	
17309041	17309055	3.03	4.05	-2.03	0.034312	0.598949	Dach1
17311104	17311111	4.13	5.15	-2.03	0.014188	0.493881	Grhl2

17365911	17365916	7.69	8.71	-2.03	0.019812	0.528572	Ablim1
17426638	17426683	7.03	8.05	-2.03	0.000778	0.276874	Ptprd
17437558	17437563	5	6.02	-2.03	0.009704	0.454586	Pcdh7
17487381	17487383	4.43	5.45	-2.03	0.035743	0.604074	Apoe
17514435	17514441	7.86	8.88	-2.03	0.004823	0.382194	Casp4
	17514442	7.21	8.56	-2.56	0.003119	0.347723	
	17514438	6.31	7.74	-2.7	0.002783	0.341626	
	17514443	8.22	9.85	-3.1	0.007046	0.415432	
	17514440	5.42	7.74	-4.98	0.002289	0.330949	
17539611	17539624	8.84	9.86	-2.03	0.001316	0.303953	Gpm6b
17217399	17217403	5.33	6.36	-2.04	0.007594	0.424026	Chi3l1
17297448	17297458	4.07	5.1	-2.04	0.041471	0.622232	Usp54
17359878	17359901	5.69	6.72	-2.04	0.004129	0.372623	Pprc1
17400901	17400910	3.38	4.41	-2.04	0.001052	0.298219	Tbx15
17405082	17405096	7.45	8.48	-2.04	0.006929	0.414726	Slc7a11
17471502	17471507	8.38	9.41	-2.04	0.003206	0.349034	Cd69
	17471503	7.82	8.93	-2.15	0.00641	0.408093	
17511714	17511715	3.68	4.71	-2.04	0.020488	0.532873	Ces1e
17514553	17514557	8.3	9.33	-2.04	0.005389	0.393508	Mmp8
	17514562	8.31	9.37	-2.1	0.000646	0.267864	
	17514559	8.59	9.78	-2.29	0.000447	0.241269	
	17514564	6.36	7.91	-2.93	0.004818	0.382194	
17522555	17522570	9.21	10.24	-2.04	0.000176	0.203054	Ltf
	17522567	8.42	9.49	-2.11	0.004241	0.373895	
	17522560	7.47	8.62	-2.22	0.0001	0.172949	
	17522558	8.26	9.54	-2.43	0.00033	0.229031	
17227780	17227788	7.89	8.92	-2.05	0.000524	0.25114	Rgs1
	17227782	5.45	6.6	-2.22	0.007193	0.416835	
	17227785	7.68	9.18	-2.82	0.001505	0.307771	
	17227787	6.3	8.05	-3.39	0.01349	0.488316	
	17227786	6.13	8.15	-4.05	0.008991	0.442402	
	17227784	2.31	5.77	-11.02	0.009098	0.443545	
17261608	17261618	3.19	4.23	-2.05	0.036838	0.607623	Gabrp
17293190	17293225	5.21	6.25	-2.05	0.027376	0.569898	Agtpbp1
	17293208	2.24	3.77	-2.89	0.014809	0.499081	
17305980	17305981	9.23	10.27	-2.05	0.005621	0.396651	Ccnb1ip1
	17305985	8.43	9.54	-2.15	0.010735	0.464182	
17333686	17333695	4.46	5.5	-2.05	0.047431	0.641038	Lix1
17370598	17370608	5.55	6.59	-2.05	0.03917	0.616034	Acvr2a
17392991	17393000	5.15	6.19	-2.05	0.02786	0.572596	Bcl2l1

	17392998	7.85	8.98	-2.19	0.001686	0.314717	
	17393001	9.05	10.23	-2.27	0.001991	0.325313	
17463338	17463342	9.38	10.41	-2.05	0.000283	0.228356	Fgf23
	17463343	8.81	9.85	-2.05	0.001309	0.303953	
	17463340	7.18	8.41	-2.34	0.001785	0.317567	
	17463339	6.26	7.62	-2.56	0.012378	0.478886	
17514936	17514938	6.34	7.37	-2.05	0.038691	0.61419	Zfp317
17225153	17225154	8.58	9.62	-2.06	0.002953	0.343464	Ncl
17374594	17374596	8.98	10.02	-2.06	0.001792	0.317789	Pak6
17410984	17410997	6.14	7.18	-2.06	0.003041	0.346859	Wdr63
17452054	17452064	8.08	9.12	-2.06	0.005804	0.399613	Oas2
	17452058	4.31	5.64	-2.52	0.001791	0.317789	
	17452065	8.12	9.61	-2.81	0.000819	0.280056	
	17452069	7.25	8.78	-2.89	0.000701	0.273976	
	17452062	7.66	9.25	-3.02	0.020426	0.532742	
	17452068	8.92	10.52	-3.03	0.000982	0.295324	
	17452063	8.79	10.43	-3.13	0.000077	0.172949	
	17452057	6.67	8.37	-3.24	0.001183	0.300915	
	17452067	8.53	10.33	-3.49	0.000055	0.163294	
	17452055	7.84	9.73	-3.71	0.004023	0.370001	
	17452061	6.84	8.81	-3.93	0.006073	0.404647	
17453242	17453266	4.88	5.92	-2.06	0.047893	0.642803	Auts2
17458439	17458446	5.04	6.08	-2.06	0.033756	0.597096	Gpnmb
17493772	17493774	6.98	8.02	-2.06	0.039061	0.615439	Dnajb13
	17493776	6.57	7.75	-2.27	0.010512	0.462344	
	17493780	5.88	7.46	-3.01	0.000429	0.240307	
	17493775	6.76	8.35	-3.02	0.014846	0.499525	
	17493773	3.44	5.11	-3.19	0.026343	0.564959	
17495839	17495845	8.55	9.59	-2.06	0.001605	0.312252	Igsf6
17499883	17499886	2.35	3.4	-2.06	0.029407	0.580038	Tpte
17517050	17517065	5.83	6.87	-2.06	0.026531	0.565769	Tmprss5
17205255	17205255	4.43	5.48	-2.06	0.020549	0.533375	
17205777	17205777	6.1	7.14	-2.06	0.044744	0.63349	
17206915	17206915	3.98	5.02	-2.06	0.038474	0.613681	
17209445	17209445	4.43	5.48	-2.06	0.020549	0.533375	
17213462	17213472	4.37	5.42	-2.07	0.049396	0.647765	Cd28
17223138	17223158	4.93	5.98	-2.07	0.016818	0.513912	Pgap1
17248911	17248921	6.35	7.41	-2.07	0.005969	0.402821	Olfr56
17337381	17337384	5.32	6.37	-2.07	0.029609	0.581341	
17389938	17389951	5.63	6.68	-2.07	0.020844	0.534257	Ltk

17403205	17403210	2.7	3.74	-2.07	0.009428	0.449287	Gbp5
17474454	17474468	9.07	10.12	-2.07	0.007704	0.426552	Dmpk
	17474461	10.21	11.29	-2.13	0.00075	0.276008	
	17474477	9.28	10.39	-2.15	0.005218	0.388645	
	17474459	9.79	10.93	-2.21	0.000901	0.285957	
	17474463	9.56	10.72	-2.23	0.001422	0.304411	
	17474466	9.6	10.79	-2.28	0.000105	0.172949	
	17474455	9.14	10.39	-2.38	0.00125	0.303268	
	17474457	6.34	7.61	-2.41	0.002317	0.331749	
	17474456	8.89	10.38	-2.8	0.002157	0.327872	
17212252	17212255	6.89	7.95	-2.08	0.001364	0.304411	Il18rap
	17212260	9.27	10.35	-2.11	0.000851	0.280074	
	17212263	8.54	9.7	-2.24	0.000379	0.236218	
	17212258	9.07	10.24	-2.26	0.002611	0.335524	
	17212257	9.32	10.52	-2.3	0.000134	0.182147	
	17212264	9.03	10.24	-2.31	0.00243	0.332021	
	17212256	7.8	9.02	-2.32	0.000014	0.120576	
	17212266	8.68	9.9	-2.34	0.000008	0.102636	
	17212265	8.56	9.79	-2.35	0.000731	0.275011	
	17212259	8.92	10.17	-2.37	0.000078	0.172949	
	17212268	8.1	9.38	-2.43	0.001889	0.320582	
	17212262	9.4	10.74	-2.53	0.000389	0.236218	
	17212261	7.95	9.35	-2.63	0.012374	0.478886	
17253810	17253817	2.62	3.68	-2.08	0.022665	0.546292	Rab11fip4
17388522	17388536	5.25	6.3	-2.08	0.032441	0.593965	Accsl
17399266	17399282	5.28	6.34	-2.08	0.007755	0.427612	Pklr
17438419	17438421	3.66	4.72	-2.08	0.040345	0.619366	
17504023	17504073	7.29	8.34	-2.08	0.035782	0.604074	Nlrc5
	17504051	7.53	8.62	-2.13	0.049911	0.649128	
17517554	17517562	5.94	7	-2.08	0.023386	0.550828	Pstpip1
17209075	17209075	4.93	5.98	-2.08	0.040788	0.620843	
17296203	17296223	3.32	4.38	-2.09	0.012948	0.483685	Il31ra
17305070	17305090	5.28	6.34	-2.09	0.003127	0.347723	Ldb3
17418094	17418096	3.31	4.37	-2.09	0.01899	0.52595	9530002B09Rik
17435643	17435656	2.5	3.56	-2.09	0.047284	0.640372	Rnf32
17463909	17463913	3.68	4.75	-2.09	0.045785	0.636001	Mgst1
17530805	17530842	2.36	3.42	-2.09	0.011049	0.46897	Dock3
17218965	17218994	3.59	4.66	-2.1	0.022514	0.545497	Adcy10
17326295	17326306	4.3	5.37	-2.1	0.0244	0.555266	Impg2
	17326298	4.31	5.41	-2.14	0.0118	0.473717	

17367652	17367656	4.47	5.54	-2.1	0.000129	0.178248	Il1f9
17396504	17396519	5.53	6.61	-2.1	0.011176	0.470088	Gm1527
17398152	17398175	6.41	7.48	-2.1	0.01296	0.483885	Gfm1
17426565	17426566	3.89	4.96	-2.1	0.029459	0.580675	Rasef
17439978	17439980	5.47	6.54	-2.1	0.039595	0.616746	Cdc7
17501877	17501878	5.89	6.96	-2.1	0.040112	0.618744	Homer3
17515988	17515990	3.02	4.09	-2.1	0.036697	0.607107	Gm7257
17223080	17223098	3.12	4.2	-2.11	0.025539	0.560515	Hecw2
17305910	17305912	4.43	5.51	-2.11	0.018988	0.52595	3632451O06Rik
17345926	17345932	3.52	4.6	-2.11	0.015705	0.505777	Satb1
17511788	17511794	3.52	4.6	-2.11	0.008825	0.440115	Ces5a
17217487	17217494	4.95	6.04	-2.12	0.015298	0.503004	Rabif
17278128	17278133	4.2	5.29	-2.12	0.032795	0.594833	Unc79
17291713	17291715	4.49	5.58	-2.12	0.008421	0.434323	Serpinb9c
17329568	17329603	5.48	6.57	-2.12	0.014922	0.500608	Atp13a4
17355113	17355122	2.81	3.9	-2.12	0.02187	0.540592	Ccbe1
17392151	17392172	5	6.08	-2.12	0.024959	0.557796	Jag1
	17392179	3.35	4.63	-2.44	0.00426	0.373895	
17438272	17438294	3.84	4.93	-2.12	0.031738	0.590482	Kit
17440042	17440049	3.19	4.28	-2.12	0.003882	0.368613	Btbd8
17445922	17445990	4.9	5.99	-2.12	0.001746	0.316762	Reln
17494643	17494644	7.81	8.9	-2.12	0.004341	0.37494	Gvin1
	17494647	8.48	9.6	-2.17	0.00041	0.236218	
17494656	17494657	7.81	8.9	-2.12	0.004341	0.37494	Gm4070
	17494660	8.48	9.6	-2.17	0.00041	0.236218	
17211548	17211552	4.87	5.96	-2.13	0.039496	0.616746	Khdrbs2
17240309	17240318	5.26	6.35	-2.13	0.017152	0.515785	BC021785
17268079	17268082	3.42	4.51	-2.13	0.040913	0.621145	Gm11546
17272722	17272741	4.55	5.64	-2.13	0.026847	0.567206	Cyth1
17292775	17292798	7.49	8.58	-2.13	0.010389	0.461344	Hk3
	17292776	7.03	8.46	-2.7	0.013098	0.484915	
17310950	17310959	6.9	7.99	-2.13	0.009707	0.454586	Pop1
17322806	17322824	4.48	5.58	-2.13	0.029972	0.583213	Atf7ip2
	17322818	5.17	6.49	-2.49	0.014157	0.493741	
17356427	17356433	6.11	7.21	-2.13	0.01172	0.47313	Ccdc85b
17410275	17410297	2.95	4.04	-2.13	0.016268	0.509987	Egf
17456868	17456879	8.93	10.02	-2.13	0.001025	0.298219	Cpa2
17508907	17508922	5.56	6.65	-2.13	0.000852	0.280074	Mtus1
	17508932	5.8	7.01	-2.33	0.01956	0.528138	
17242232	17242246	5.13	6.23	-2.14	0.009215	0.445699	Col18a1

17253494	17253503	3.97	5.07	-2.14	0.028001	0.573149	Proca1
17264651	17264671	5.22	6.32	-2.14	0.012775	0.482623	Kdm6b
	17264662	4.84	6.22	-2.6	0.044628	0.633123	
17318923	17318926	3.62	4.72	-2.14	0.015346	0.503286	Cacng2
17322402	17322404	3.86	4.95	-2.14	0.007277	0.418219	Gtsf1
	17322403	3.95	5.94	-3.96	0.000182	0.206107	
	17322405	3.29	5.43	-4.39	0.003354	0.352362	
	17322411	2.98	5.57	-6.03	0.006016	0.403696	
	17322408	4.37	7.83	-10.98	0.000094	0.172949	
	17322409	4.37	8.29	-15.2	0.00002	0.12396	
17335540	17335548	9.43	10.53	-2.14	0.003292	0.351744	Pim
	17335542	9.81	11.21	-2.64	0.001893	0.320822	
	17335545	11.15	12.58	-2.71	0.000033	0.140355	
	17335549	8.86	10.47	-3.05	0.000017	0.123763	
	17335546	9.73	11.39	-3.16	0.000085	0.172949	
	17335544	10.28	11.98	-3.24	0.000165	0.199479	
	17335547	10.27	12.15	-3.68	0.000004	0.091	
17343057	17343062	7.7	9.46	-3.4	0.000609	0.263917	
17419389	17419399	7.3	8.4	-2.14	0.01216	0.476904	Snhg12
17445809	17445829	5.14	6.24	-2.14	0.027493	0.570402	Ccdc146
17530159	17530173	4.5	5.59	-2.14	0.02849	0.57553	Ppp2r3a
17235037	17235039	6.17	7.27	-2.15	0.021095	0.535824	Arid3a
17265082	17265084	7.81	8.91	-2.15	0.000173	0.203054	Eif5a
17325386	17325399	4.48	5.59	-2.15	0.002209	0.329597	Iqcb1
17347236	17347238	5.78	6.89	-2.15	0.001632	0.312252	Nlrc4
	17347245	5.84	7.43	-3.02	0.004709	0.380705	
17394232	17394237	4.45	5.55	-2.15	0.010855	0.465777	Wfdc9
17419840	17419846	5.93	7.04	-2.15	0.002583	0.335266	Runx3
17447940	17447955	5.97	7.08	-2.15	0.02902	0.578523	Lcorl
17459108	17459121	2.8	3.91	-2.15	0.018472	0.523835	Fam190a
17540589	17540603	5.2	6.31	-2.15	0.036006	0.605013	Klhl13
17225929	17225961	7.87	8.98	-2.16	0.019295	0.527066	Pam
17233646	17233655	6.23	7.34	-2.16	0.005681	0.397411	4632428N05Rik
17267996	17268006	6.11	7.21	-2.16	0.002193	0.32876	Rsad1
17302279	17302286	6.48	7.59	-2.16	0.002638	0.335941	Olfm4
	17302285	6.27	8.15	-3.69	0.003043	0.346859	
17228906	17228915	4.06	5.18	-2.17	0.007489	0.422431	Dnm3
17286421	17286423	2.53	3.65	-2.17	0.013396	0.48781	
17304768	17304784	3.88	4.99	-2.17	0.00477	0.381597	Colq
17325892	17325893	4.32	5.44	-2.17	0.02384	0.553786	Cd200r3

	17325898	4.13	5.6	-2.77	0.023221	0.549956	
17330203	17330207	4.81	5.93	-2.17	0.009728	0.454586	Cd86
17380555	17380565	5.16	6.27	-2.17	0.007392	0.419877	Gm14403
17398460	17398466	5.95	7.07	-2.17	0.014389	0.495396	Mtap9
17436481	17436491	4.23	5.35	-2.17	0.01062	0.464024	Fgfr3
17449964	17449979	3.49	4.61	-2.17	0.001404	0.304411	Prkg2
17480880	17480891	5.81	6.93	-2.17	0.017167	0.515785	Pde2a
17222527	17222534	5.51	6.63	-2.18	0.003936	0.369901	Tbc1d8
	17222531	3.03	4.32	-2.45	0.024482	0.555606	
17231522	17231528	5.5	6.62	-2.18	0.021928	0.540839	Lrp11
17241849	17241850	5.38	6.51	-2.18	0.025024	0.558201	Susd2
	17241854	3.51	5.24	-3.32	0.003575	0.360273	
17333553	17333554	3.79	4.91	-2.18	0.037044	0.608498	Fam120b
17364463	17364471	4.37	5.49	-2.18	0.03522	0.601741	Cyp2c70
17441595	17441599	5.98	7.11	-2.18	0.000769	0.276874	Tbx3
17459960	17459978	7.2	8.32	-2.18	0.018538	0.523911	Rtkn
17468573	17468591	2.96	4.08	-2.18	0.04207	0.624667	Antxr1
17477835	17477845	5.97	7.1	-2.18	0.001001	0.296859	Tulp2
17527810	17527815	3.93	5.05	-2.18	0.031982	0.59137	Tmem202
17531075	17531076	4.37	5.5	-2.18	0.006357	0.40803	6230427J02Rik
	17531077	7.32	8.58	-2.38	0.000445	0.241173	
17249994	17249996	6.43	7.56	-2.19	0.015264	0.502931	4930438A08Rik
17290781	17290787	4.19	5.32	-2.19	0.010437	0.461454	5033411D12Rik
17325339	17325341	5.15	6.29	-2.19	0.0242	0.555183	2010005H15Rik
17407138	17407144	4.22	5.36	-2.19	0.028706	0.576863	Il6ra
17415635	17415692	2.24	3.37	-2.19	0.011915	0.474805	Inadl
17442237	17442238	2.85	3.98	-2.19	0.030273	0.584215	Wdr66
17460366	17460371	7.09	8.22	-2.19	0.00214	0.327666	Add2
	17460376	6.15	7.53	-2.6	0.019577	0.528138	
17500535	17500539	8.25	9.39	-2.19	0.019471	0.527838	Dusp4
17316280	17316284	3.5	4.64	-2.2	0.024204	0.555183	Ankrd33b
17373754	17373769	4.94	6.08	-2.2	0.011667	0.472965	Abtb2
17383892	17383897	8.78	9.91	-2.2	0.010701	0.464161	Lcn2
	17383902	7.87	9.03	-2.24	0.011882	0.474638	
17404058	17404070	4.6	5.74	-2.2	0.000733	0.275011	Pag1
17521070	17521085	5.84	6.98	-2.2	0.045443	0.635402	Mrpl3
17544220	17544233	3.46	4.6	-2.2	0.019077	0.526155	Pof1b
17210723	17210723	4.8	5.94	-2.2	0.030927	0.586777	
17316878	17316924	5.79	6.93	-2.21	0.034589	0.599507	Csmd3
	17316906	2.77	5.32	-5.89	0.031567	0.589729	

17344472	17344489	5.45	6.59	-2.21	0.005647	0.396691	Atat1
	17344490	2.87	4.4	-2.88	0.009597	0.452953	
	17344476	4.35	5.98	-3.09	0.032674	0.594712	
17422319	17422335	2.64	3.79	-2.21	0.005593	0.396536	Wdr8
17499485	17499521	3.57	4.71	-2.21	0.017898	0.520713	Myom2
17219519	17219521	4.79	5.94	-2.22	0.039008	0.615237	Igsf8
17235300	17235319	5.32	6.47	-2.22	0.018752	0.525138	Apc2
17237608	17237626	3.6	4.76	-2.22	0.012191	0.477315	Grip1
	17237643	3.08	4.7	-3.06	0.034204	0.598664	
17238722	17238726	3.57	4.72	-2.22	0.007959	0.429748	H60c
17297125	17297133	3.25	4.4	-2.22	0.006203	0.407159	Ptprg
17437213	17437218	4.53	5.68	-2.22	0.049861	0.649107	Cd38
17475360	17475363	6.07	7.23	-2.22	0.014873	0.499856	Cyp2b10
17478386	17478389	4.35	5.5	-2.22	0.021506	0.538235	Slc6a5
17214924	17214938	5.17	6.32	-2.23	0.01865	0.524405	Sp140
17269870	17269881	6.57	7.72	-2.23	0.008407	0.434166	Ptges3l
17290457	17290470	3.15	4.31	-2.23	0.010245	0.46081	Ryr2
17385281	17385282	5.03	6.18	-2.23	0.015833	0.506864	Cacnb4
17418581	17418586	4.18	5.34	-2.23	0.031974	0.59137	Col8a2
17450354	17450355	4.24	5.4	-2.23	0.014048	0.493041	Hsd17b13
17480466	17480474	4.22	5.37	-2.23	0.042746	0.628031	Gucy2d
17224661	17224668	4.72	5.88	-2.24	0.018922	0.52595	Epha4
17244175	17244176	4.63	5.79	-2.24	0.014806	0.499081	Slc25a3
17272785	17272786	9.04	10.2	-2.24	0.002485	0.332021	Lgals3bp
	17272791	6.43	8.04	-3.07	0.000221	0.210168	
17286020	17286021	5.22	6.39	-2.24	0.007425	0.420695	D130043K22Rik
	17286024	3.4	4.78	-2.61	0.038587	0.613876	
17289281	17289286	6.75	7.91	-2.24	0.027481	0.570345	F2rl2
	17289284	9.04	10.31	-2.42	0.000853	0.280074	
	17289285	9.85	11.16	-2.48	0.003906	0.369167	
17324546	17324548	3.17	4.33	-2.24	0.008521	0.435248	Ostn
17368762	17368775	5.69	6.86	-2.24	0.03129	0.588316	Ddx31
17397968	17397985	4.24	5.41	-2.24	0.02333	0.550788	Arhgef26
17452115	17452122	4.27	5.43	-2.24	0.00691	0.414613	Oas1g
	17452121	3.86	5.24	-2.59	0.022791	0.547136	
17470613	17470614	5.26	6.42	-2.24	0.018429	0.523504	Foxj2
17521300	17521312	8.83	9.99	-2.24	0.01415	0.493741	Cish
17541528	17541557	2.18	3.34	-2.24	0.029773	0.582151	Igsf1
17228136	17228144	6.99	8.16	-2.25	0.008563	0.435999	Lamc2
	17228139	3.84	5.25	-2.66	0.048201	0.644063	

17237451	17237489	4.34	5.51	-2.25	0.043761	0.63057	Ptprb
17243406	17243416	5.48	6.65	-2.25	0.004887	0.383328	Tle6
17366992	17366999	8.27	9.43	-2.25	0.005606	0.396536	Il2ra
17380915	17380927	3.67	4.84	-2.25	0.031756	0.590617	Col20a1
17436659	17436667	3.78	4.95	-2.25	0.007463	0.421943	Grk4
	17436671	3.35	4.69	-2.53	0.043882	0.63095	
17456934	17456940	3.57	4.74	-2.25	0.030675	0.585609	Mest
17381717	17381747	4.71	5.89	-2.26	0.018143	0.521433	Itga8
17450645	17450654	5.11	6.29	-2.26	0.020421	0.532742	Glmn
17462437	17462439	8.19	9.37	-2.26	0.000759	0.276874	Usp18
	17462445	9.18	10.4	-2.34	0.0011	0.299582	
	17462447	9.33	10.56	-2.35	0.000258	0.22192	
	17462444	8.9	10.15	-2.37	0.005349	0.392276	
	17462443	7.25	8.66	-2.66	0.002085	0.327223	
	17462438	7.91	9.39	-2.78	0.006339	0.40803	
	17462446	8.93	10.43	-2.85	0.000099	0.172949	
	17462450	7.81	9.49	-3.22	0.000242	0.218071	
	17462449	7.73	9.5	-3.4	0.000097	0.172949	
	17462448	7.2	9.21	-4.03	0.00508	0.386255	
	17462441	5.98	8.21	-4.67	0.032669	0.594712	
17465636	17465664	4.58	5.75	-2.26	0.011999	0.475304	Plxna4
17510823	17510827	4.63	5.81	-2.26	0.01735	0.517057	Gab1
17519316	17519335	2.4	3.57	-2.26	0.024241	0.555183	Wdr72
17200967	17200967	5.64	6.81	-2.26	0.007564	0.423575	
17254458	17254460	3.16	4.35	-2.27	0.008462	0.434529	1500016L03Rik
17313106	17313119	2.58	3.76	-2.27	0.005112	0.387132	Cacna1i
	17313146	5.42	6.85	-2.69	0.040461	0.619856	
17445833	17445834	2.18	3.37	-2.27	0.034207	0.598664	Fbxl13
	17445851	4.76	6.03	-2.42	0.025006	0.558201	
17460185	17460228	3.7	4.88	-2.27	0.034604	0.599511	Dysf
17536624	17536648	5.52	6.7	-2.27	0.004859	0.382242	Dlg3
	17536650	7.15	8.43	-2.43	0.019375	0.527402	
	17536645	5.43	6.92	-2.79	0.028302	0.574911	
17262990	17263000	5.9	7.08	-2.28	0.004466	0.378259	Sparc
17278662	17278678	3.57	4.76	-2.28	0.009665	0.454019	Meg3
17325044	17325049	5.02	6.21	-2.28	0.024672	0.556864	Slc12a8
17346603	17346606	5.57	6.76	-2.28	0.005435	0.393779	2610034M16Rik
17363644	17363649	6	7.19	-2.28	0.010065	0.457836	Cbwd1
17391112	17391117	5.05	6.24	-2.28	0.008212	0.43107	Gabpb1
17421452	17421461	7.17	8.36	-2.28	0.035888	0.604671	

	17421456	6.67	8.13	-2.75	0.005663	0.397208	
17441037	17441049	7.59	8.77	-2.28	0.027148	0.569344	Oasl2
17522338	17522343	6.12	7.32	-2.28	0.044672	0.633123	Scap
17212229	17212244	5.94	7.14	-2.29	0.014827	0.499504	Il18r1
	17212240	5.69	7.68	-3.99	0.000111	0.176018	
	17212239	3.56	6.07	-5.72	0.008837	0.44016	
17288992	17289005	3.9	5.1	-2.29	0.011819	0.473914	Edil3
17356633	17356639	5.05	6.25	-2.29	0.020878	0.534257	Gm550
17523633	17523638	4.5	5.7	-2.29	0.045166	0.634628	Ccr9
17531751	17531787	3.01	4.21	-2.29	0.02971	0.582034	Arpp21
17535048	17535050	3.27	4.46	-2.29	0.008987	0.442402	Cd40lg
17257568	17257574	5.34	6.55	-2.3	0.035752	0.604074	Tcam1
17428094	17428112	5.11	6.31	-2.3	0.026247	0.564206	Zfyve9
17206365	17206365	3.51	4.71	-2.3	0.026661	0.565921	
17261896	17261906	4.63	5.84	-2.31	0.037226	0.60926	Gabra1
17282025	17282053	6.02	7.22	-2.31	0.021936	0.540947	Spnb1
17370103	17370117	6.84	8.05	-2.31	0.004569	0.378259	Hspa5
17267954	17267955	5.05	6.26	-2.32	0.001291	0.303953	Epn3
17326756	17326764	3.55	4.76	-2.32	0.009968	0.456055	Ncam2
17376423	17376436	5.5	6.72	-2.32	0.025286	0.559286	Hspa12b
17523387	17523397	7.28	8.49	-2.32	0.021841	0.540463	Fam198a
	17523394	6.68	8.79	-4.32	0.000602	0.26328	
	17523391	6.69	8.92	-4.68	0.000735	0.275011	
	17523395	6.94	9.21	-4.84	0.015587	0.505297	
	17523392	5.82	8.55	-6.61	0.00083	0.280074	
	17523396	5.82	8.98	-8.93	0.00018	0.205752	
17249079	17249087	3.16	4.38	-2.33	0.03331	0.595925	Rasgef1c
17271139	17271140	3.91	5.13	-2.34	0.032363	0.593183	
17285036	17285051	4.25	5.48	-2.34	0.015689	0.505777	Adarb2
17326472	17326488	5.74	6.97	-2.34	0.039145	0.615854	Mina
17330246	17330256	5.84	7.07	-2.34	0.02554	0.560515	Eaf2
17351143	17351158	2.96	4.19	-2.34	0.031738	0.590482	Sh3tc2
17455319	17455325	5.31	6.54	-2.34	0.0498	0.648607	Flt3
	17455326	2.43	3.87	-2.72	0.003915	0.369493	
	17455320	3.53	5.16	-3.09	0.025438	0.560063	
17463761	17463770	3.65	4.88	-2.34	0.028457	0.575288	8430419L09Rik
17471480	17471482	6.46	7.68	-2.34	0.004698	0.380705	Gm15987
17502921	17502936	3.07	4.3	-2.34	0.022269	0.543881	Clgn
	17502938	5.12	6.59	-2.77	0.01169	0.47313	
17228252	17228275	4.14	5.37	-2.35	0.041795	0.623424	Rgsl1

17323711	17323720	5.56	6.79	-2.35	0.038924	0.614952	Txnrd2
17335842	17335848	2.92	4.15	-2.35	0.023259	0.550316	Pde9a
17363445	17363451	6.79	8.03	-2.35	0.039227	0.61615	Tmc1
17476800	17476806	5	6.24	-2.35	0.013903	0.49229	Slc7a9
17266960	17266962	7.57	8.81	-2.36	0.000002	0.083716	Ccl6
	17266964	6.9	8.47	-2.97	0.002695	0.337856	
	17266965	5.8	7.4	-3.03	0.001901	0.321102	
	17266961	8.11	9.81	-3.26	0.000253	0.219999	
17276396	17276401	4.01	5.26	-2.36	0.020292	0.532145	Syne2
17369672	17369674	5.66	6.9	-2.36	0.039488	0.616746	Ppapdc3
17236204	17236205	3.29	4.53	-2.37	0.017963	0.520713	BC030307
17261069	17261092	4.03	5.28	-2.37	0.042541	0.627002	0610010F05Rik
17325946	17325972	4.95	6.19	-2.37	0.014447	0.495666	Slc9a10
17340845	17340886	5.57	6.82	-2.37	0.007907	0.429308	Igf2r
17342051	17342064	3.64	4.89	-2.37	0.045917	0.636251	Eme2
17394366	17394369	3.7	4.94	-2.37	0.044677	0.633123	Cdh22
17411364	17411391	2.69	3.93	-2.37	0.001412	0.304411	Tnni3k
17491763	17491769	6.98	8.22	-2.37	0.023434	0.550828	Chrna7
17493552	17493555	3.87	5.11	-2.37	0.013207	0.486175	B3gnt6
17206865	17206865	4.69	5.94	-2.37	0.006686	0.412981	
17308928	17308935	2.6	3.85	-2.38	0.018881	0.525689	Lect1
17330967	17330986	4.15	5.4	-2.38	0.033621	0.596967	Nfkbiz
17405606	17405611	2.47	3.73	-2.38	0.014759	0.498463	Vmn2r2
17451549	17451560	4.46	5.71	-2.38	0.000909	0.286879	Trpv4
17487898	17487901	5.58	6.83	-2.38	0.018795	0.525156	Erf
17508938	17508948	5.46	6.71	-2.38	0.003287	0.351677	Fgl1
17538096	17538108	4.26	5.51	-2.38	0.0058	0.399613	Rnf128
	17538104	4.19	6.14	-3.86	0.001223	0.302414	
	17538106	4.48	6.8	-5	0.005427	0.393508	
	17538102	3.7	6.1	-5.25	0.001535	0.309911	
	17538107	3.12	6.38	-9.59	0.000981	0.295324	
17223616	17223627	3.35	4.6	-2.39	0.010286	0.461143	Raph1
17308842	17308864	3.02	4.28	-2.39	0.026609	0.565769	Dgkh
17326318	17326333	5.66	6.91	-2.39	0.007907	0.429308	Abi3bp
17380578	17380581	5.3	6.56	-2.39	0.001019	0.298219	Etohi1
17393859	17393865	6.81	8.07	-2.39	0.003585	0.360273	Gm826
17394647	17394656	4.52	5.78	-2.39	0.007339	0.418985	Znfx1
17399496	17399499	5.7	6.96	-2.39	0.038178	0.612611	Adar
17410251	17410270	6.47	7.73	-2.39	0.027856	0.572546	Enpep
17427367	17427372	3.98	5.24	-2.4	0.0172	0.51594	Cyp2j11

17255899	17255902	5.06	6.33	-2.41	0.006745	0.413237	B230217C12Rik
	17255901	6.58	8.2	-3.07	0.000574	0.259944	
17276364	17276370	5.98	7.25	-2.41	0.014535	0.49636	Syt16
17339142	17339149	5.86	7.12	-2.41	0.027639	0.571191	Ppp4r1
17401970	17401983	3.83	5.1	-2.41	0.002793	0.341644	Olfm3
17408625	17408626	3.23	4.5	-2.41	0.002264	0.330949	Nr1h5
17464588	17464604	3.03	4.3	-2.41	0.024054	0.554833	Sgce
17486270	17486273	5.14	6.41	-2.41	0.01777	0.519909	Vmn2r42
17499155	17499209	6.16	7.43	-2.41	0.037376	0.609865	Mcf2l
17218643	17218651	3.07	4.35	-2.42	0.021839	0.540463	Serpinc1
17226269	17226284	4.47	5.75	-2.42	0.012895	0.482967	Gm101
	17226292	3.3	4.63	-2.51	0.011854	0.474616	
17381357	17381369	4.27	5.54	-2.42	0.025179	0.558937	Camk1d
17395414	17395441	3.22	4.49	-2.42	0.039635	0.616746	Sycp2
17465115	17465151	3.88	5.15	-2.42	0.024138	0.555096	Cadps2
17533031	17533034	9.01	10.28	-2.42	0.000331	0.229031	Pim2
	17533032	8.71	10.4	-3.22	0.000701	0.273976	
	17533036	10.94	12.7	-3.38	0.000016	0.120576	
	17533039	7.57	9.34	-3.41	0.000216	0.209449	
17535644	17535666	3.24	4.52	-2.42	0.03076	0.585925	Plxnb3
17227616	17227634	4.22	5.5	-2.43	0.049248	0.646981	Crb1
17403168	17403176	3.06	4.34	-2.43	0.000353	0.236218	B930007M17Rik
17415897	17415905	5.21	6.49	-2.43	0.001963	0.324676	Raver2
17417620	17417621	2.99	4.28	-2.43	0.007933	0.429534	
17490149	17490153	7.44	8.72	-2.43	0.011235	0.470646	Cd33
17332395	17332412	5.85	7.14	-2.44	0.037443	0.610026	Brwd1
17332783	17332791	4.72	6	-2.44	0.004379	0.375494	Snx9
17362998	17363004	7.08	8.37	-2.44	0.00338	0.353496	Ms4a3
17402386	17402398	5.3	6.59	-2.44	0.027306	0.569752	Prss12
17402877	17402888	7.55	8.84	-2.44	0.000357	0.236218	Nhedc1
	17402878	9.13	10.56	-2.69	0.000141	0.185997	
	17402882	5.84	7.5	-3.14	0.007601	0.424197	
	17402880	4.42	6.62	-4.57	0.000776	0.276874	
	17402892	3.96	6.33	-5.18	0.002039	0.327213	
	17402884	5.43	8.09	-6.31	0.00542	0.393508	
	17402891	4.94	7.6	-6.32	0.001542	0.310409	
	17402879	6.2	9.41	-9.26	0.000005	0.101102	
	17402881	3.61	6.99	-10.41	0.010543	0.462887	
	17402886	2.14	7.07	-30.51	0.000087	0.172949	
17460728	17460736	6.17	7.46	-2.44	0.031291	0.588316	Txnrd3

17390879	17390906	2.87	4.17	-2.45	0.038313	0.612985	Fbn1
	17390928	3.21	4.69	-2.78	0.048969	0.646475	
17411848	17411855	3.85	5.14	-2.45	0.023273	0.550334	Cdh17
	17411867	5.48	6.86	-2.59	0.020267	0.532102	
	17411854	4.79	6.69	-3.74	0.0004	0.236218	
17426402	17426426	3.93	5.22	-2.45	0.010007	0.456444	Astn2
17445507	17445511	4.71	6	-2.45	0.019452	0.527666	Dbf4
17452070	17452077	7.57	8.86	-2.45	0.000121	0.176411	Oas3
17291026	17291027	5.38	6.67	-2.46	0.008179	0.430797	Mir1983
17432729	17432735	2.27	3.57	-2.46	0.002086	0.327223	LOC100862027
17443833	17443843	4.49	5.79	-2.46	0.025554	0.560644	Stag3
	17443834	2.78	4.96	-4.54	0.012009	0.475398	
	17443870	3.13	5.51	-5.22	0.014358	0.495353	
	17443850	2.35	5.4	-8.3	0.019234	0.527066	
17309482	17309489	5.8	7.1	-2.47	0.032179	0.592431	Uggt2
17421704	17421715	5.15	6.45	-2.47	0.019247	0.527066	Masp2
17221553	17221576	2.25	3.56	-2.48	0.041649	0.622845	Pkhd1
17249362	17249366	4.27	5.57	-2.48	0.000503	0.250315	Sar1b
17263089	17263109	5.29	6.6	-2.48	0.03039	0.584389	Gemin5
	17263111	6.25	7.65	-2.64	0.036864	0.607623	
17468143	17468148	4.85	6.16	-2.48	0.00248	0.332021	Mthfd2
17517001	17517022	4.58	5.89	-2.48	0.021918	0.540825	Usp28
17545553	17545555	4.28	5.59	-2.48	0.037588	0.610572	Magea3
17280934	17280943	2.92	4.24	-2.49	0.040419	0.619774	Prkd1
17322750	17322771	4.23	5.54	-2.49	0.000173	0.203054	Abat
17382186	17382193	5.4	6.72	-2.49	0.027571	0.570822	Spopl
17498271	17498300	5.42	6.74	-2.49	0.011172	0.470088	Cars
17214027	17214030	2.44	3.76	-2.5	0.02004	0.530637	B930094L07Rik
17275436	17275448	1.99	3.31	-2.5	0.003297	0.351844	Akap6
17225379	17225389	2.05	3.38	-2.51	0.032027	0.591526	Asb18
17337750	17337756	4.96	6.28	-2.51	0.017115	0.515567	Gpr110
17339824	17339827	2.49	3.82	-2.51	0.02346	0.550828	Vit
17483264	17483297	3.41	4.74	-2.51	0.040359	0.619366	Itgal
17249980	17249986	6.59	7.92	-2.52	0.00779	0.427867	Igtp
17355026	17355044	2.9	4.24	-2.52	0.010836	0.465777	Atp8b1
17405420	17405429	4.69	6.03	-2.52	0.044624	0.633123	Fam194a
17295308	17295322	4.37	5.71	-2.53	0.049077	0.646667	Rgnef
17337706	17337712	5.76	7.1	-2.53	0.041801	0.623424	Rhag
	17337718	5.31	7.38	-4.21	0.012736	0.482251	
	17337714	5.31	7.51	-4.57	0.009875	0.455716	

	17337717	4.53	6.76	-4.71	0.003882	0.368613	
17354219	17354228	6.27	7.62	-2.54	0.035415	0.602418	Trim36
17354906	17354942	4.48	5.82	-2.54	0.017866	0.520713	Fam38b
	17354912	3.87	5.68	-3.5	0.007753	0.427612	
17469506	17469512	3.68	5.02	-2.54	0.021309	0.537248	Cntn3
17500876	17500918	3.48	4.82	-2.54	0.012551	0.480471	Sorbs2
17302802	17302830	6.06	7.41	-2.55	0.005607	0.396536	Farp1
17365803	17365835	2.16	3.51	-2.55	0.029767	0.582128	Nrap
17461114	17461122	2.31	3.66	-2.55	0.041147	0.622107	Fam19a1
17492892	17492895	4.65	6	-2.55	0.002992	0.344778	4933430H16Rik
17212840	17212846	3.58	4.94	-2.56	0.027258	0.569749	Ccdc150
17323120	17323121	5.1	6.45	-2.56	0.019105	0.526639	Nde1
17520886	17520902	2.61	3.97	-2.56	0.021488	0.538197	Ryk
17361435	17361440	2.77	4.13	-2.57	0.047504	0.641222	Npas4
17466060	17466072	2.61	3.97	-2.57	0.046901	0.639365	Parp12
17507623	17507627	3.61	4.97	-2.57	0.001452	0.304414	1700029H14Rik
17227729	17227740	4.57	5.93	-2.58	0.034807	0.600281	Cdc73
17366597	17366610	3.87	5.24	-2.58	0.024247	0.555183	Usp6nl
17370527	17370547	2.84	4.2	-2.58	0.032029	0.591526	Kynu
17447379	17447380	3.07	4.44	-2.58	0.004791	0.382194	Sh3tc1
17256697	17256703	4.1	5.47	-2.59	0.049768	0.648556	Aoc3
17264314	17264316	5.03	6.41	-2.59	0.030688	0.585682	
17514424	17514431	7.2	8.58	-2.59	0.007598	0.42415	Casp1
	17514429	7.39	8.82	-2.7	0.001463	0.304776	
17463689	17463700	5.93	7.3	-2.6	0.020378	0.532709	Bcl2l14
17467589	17467606	4.21	5.59	-2.6	0.028055	0.573661	Smyd1
17482381	17482399	3.38	4.76	-2.6	0.0258	0.561887	Abca14
17516691	17516696	3.57	4.95	-2.6	0.043262	0.629143	Cd3d
17215251	17215266	3.4	4.78	-2.61	0.003083	0.347338	Gigyf2
17324185	17324187	4.57	5.95	-2.61	0.048562	0.645442	Vps8
17439769	17439775	4.29	5.67	-2.61	0.025924	0.562725	Nudt9
17253707	17253713	3.29	4.67	-2.62	0.004196	0.373818	Nos2
17447963	17447966	3.96	5.35	-2.62	0.021716	0.53992	Kcnip4
17449473	17449481	2.43	3.82	-2.62	0.042497	0.626741	Gc
17301558	17301564	3.77	5.16	-2.63	0.001264	0.303543	Kctd9
17442609	17442687	3.53	4.92	-2.63	0.029085	0.578884	Dnahc10
17240123	17240127	4.38	5.78	-2.64	0.047985	0.643183	Clvs2
17456721	17456735	6.77	8.17	-2.64	0.020027	0.530498	Smo
17460714	17460722	4.51	5.91	-2.64	0.030561	0.584967	Gm1965
17478698	17478714	2.96	4.36	-2.64	0.023114	0.549792	Oca2

17529398	17529409	5	6.4	-2.64	0.030296	0.584227	Me1
17216186	17216190	2.88	4.28	-2.65	0.002007	0.325313	Gm7135
17328070	17328072	4.59	6	-2.65	0.015991	0.508065	Tekt5
17386639	17386648	1.98	3.38	-2.65	0.003372	0.352871	Lnp
17505478	17505490	3.56	4.97	-2.65	0.045864	0.636147	Tat
17325135	17325142	2.37	3.79	-2.67	0.040432	0.619794	Ropn1
17501520	17501527	4.83	6.24	-2.67	0.004569	0.378259	01-Mar
17220844	17220845	4.68	6.11	-2.68	0.025573	0.560669	Nek2
17263568	17263572	5.69	7.11	-2.68	0.013029	0.484609	Tom1l2
17359636	17359654	2.31	3.73	-2.68	0.000499	0.249499	Abcc2
17423215	17423218	5.09	6.51	-2.68	0.006137	0.405929	2310030N02Rik
17293165	17293175	3.04	4.47	-2.69	0.014622	0.497127	Slc28a3
17239384	17239396	4.14	5.57	-2.7	0.034111	0.598357	Phactr2
17211587	17211644	4.3	5.73	-2.71	0.041924	0.624172	Dst
17303412	17303431	4.42	5.86	-2.71	0.024048	0.554833	Acox2
17308413	17308424	3.82	5.25	-2.71	0.043809	0.630639	Epb4.9
17445008	17445026	3.04	4.48	-2.71	0.040333	0.619303	Wdr95
17453839	17453871	3.48	4.92	-2.72	0.007802	0.42789	Muc3
17477254	17477258	5.65	7.09	-2.72	0.045945	0.636313	Klk6
17497980	17497986	5.4	6.84	-2.72	0.048813	0.646209	Muc6
17255626	17255640	2.15	3.6	-2.73	0.015364	0.503586	Skap1
17335628	17335701	2.92	4.37	-2.73	0.040454	0.619856	Dnahc8
17377778	17377779	6.16	7.61	-2.73	0.011466	0.472283	Id1
	17377780	7.76	9.45	-3.22	0.000115	0.176411	
	17377783	10.1	12.22	-4.34	0.000008	0.102636	
	17377784	9.13	11.25	-4.34	0.000183	0.206301	
	17377782	5.83	8.19	-5.15	0.000034	0.140355	
17393143	17393145	3.01	4.46	-2.73	0.002979	0.344158	Necab3
17385797	17385808	6.24	7.69	-2.74	0.000441	0.240336	Ifih1
17266534	17266556	4.76	6.22	-2.75	0.035491	0.602418	Ksr1
17365571	17365576	3.6	5.06	-2.75	0.039508	0.616746	Wdr96
17473248	17473250	3.74	5.2	-2.75	0.02217	0.543177	Ttyh1
17244439	17244461	3.76	5.23	-2.76	0.004158	0.372623	Plxnc1
17463851	17463868	2.4	3.86	-2.76	0.005874	0.401296	Ptpro
17201745	17201745	5.01	6.47	-2.76	0.040645	0.620373	
17201921	17201921	5.01	6.47	-2.76	0.040645	0.620373	
17405285	17405287	2.99	4.45	-2.77	0.04227	0.625834	Nbea
17351351	17351361	3.52	4.99	-2.78	0.004527	0.378259	Zfp532
17459826	17459829	2.17	3.64	-2.78	0.015831	0.506864	Fam176a
17483577	17483592	4.27	5.74	-2.78	0.033687	0.596967	Itgam

17335798	17335814	5.65	7.13	-2.79	0.001333	0.304052	Ubash3a
	17335806	5.4	6.89	-2.8	0.012588	0.480866	
	17335805	5.34	7.1	-3.41	0.006181	0.406576	
	17335809	3.29	6.12	-7.1	0.001079	0.298219	
	17335811	3.97	6.94	-7.86	0.000328	0.228882	
	17335813	4.94	7.93	-7.95	0.001601	0.312252	
	17335807	3.61	6.81	-9.23	0.004031	0.370069	
	17335816	3.74	7.76	-16.27	0.001546	0.310409	
17492078	17492095	2.36	3.84	-2.79	0.001759	0.316762	Mctp2
17269521	17269527	4.89	6.38	-2.8	0.015474	0.504439	Acly
17280842	17280854	7.35	8.83	-2.8	0.031721	0.590383	Ifrd1
17271443	17271472	3.07	4.56	-2.81	0.045555	0.635758	Abca6
17276105	17276135	5.26	6.75	-2.81	0.04301	0.628442	2700049A03Rik
17360260	17360270	3.99	5.48	-2.81	0.029122	0.579097	Sorcs3
17446669	17446685	5.68	7.17	-2.81	0.032472	0.594148	Gpr113
17375665	17375666	5.59	7.08	-2.82	0.040389	0.619493	Galk2
17216031	17216038	4.59	6.1	-2.83	0.020002	0.530283	Farp2
17239546	17239558	3.91	5.41	-2.83	0.020427	0.532742	D10Bwg1379e
17262464	17262465	3.84	5.34	-2.83	0.02635	0.564983	5133400J02Rik
17243544	17243557	5.5	7	-2.84	0.047725	0.642125	Aldh1l2
17308058	17308067	6.54	8.05	-2.84	0.013831	0.491488	Adam7
17343962	17343968	4.65	6.16	-2.84	0.027656	0.571399	Cyp21a1
17351082	17351106	2.96	4.46	-2.84	0.027239	0.569749	Pde6a
17421437	17421441	9.35	10.86	-2.84	0.003053	0.347338	Gm13247
17255260	17255306	5.8	7.31	-2.85	0.036013	0.605013	Col1a1
	17255310	5.15	7.32	-4.5	0.045092	0.634387	
17231387	17231418	3.25	4.76	-2.86	0.019074	0.526155	Mthfd1l
17227160	17227173	3.51	5.03	-2.87	0.00541	0.393508	Ppp1r12b
17323888	17323908	5.35	6.87	-2.87	0.038591	0.613899	Eif2b5
17326105	17326107	2.96	4.48	-2.87	0.007505	0.422719	Myh15
17530930	17530945	2.29	3.81	-2.87	0.009075	0.442983	Sema3b
17303504	17303533	3.03	4.56	-2.88	0.020849	0.534257	Cadps
17400250	17400252	4.85	6.38	-2.88	0.024121	0.555096	Sema6c
17484000	17484004	4.68	6.21	-2.89	0.001378	0.304411	Fam24a
17325874	17325876	4.11	5.64	-2.9	0.025572	0.560669	Cd200r4
17347571	17347604	2.91	4.45	-2.9	0.045983	0.63632	Map4k3
17536078	17536104	2.24	3.78	-2.9	0.029249	0.579523	Dmd
	17536088	3.26	5.22	-3.88	0.002943	0.34341	
17369379	17369475	3.79	5.33	-2.91	0.036709	0.607107	
17376252	17376254	4.28	5.82	-2.91	0.032044	0.591607	Nop56

17546854	17546867	2.73	4.27	-2.92	0.000572	0.259944	Usp9y
17265570	17265593	3	4.56	-2.94	0.042814	0.628284	Pitpnm3
17370234	17370259	5.75	7.31	-2.94	0.00206	0.327223	Dab2ip
	17370255	4.54	6.88	-5.04	0.017021	0.515002	
	17370260	4.33	7.51	-9.09	0.000212	0.209449	
	17370245	3.48	6.93	-10.9	0.000156	0.192643	
	17370258	4.29	7.88	-12.1	0.000297	0.228356	
17425095	17425101	4.36	5.92	-2.95	0.015932	0.507731	Gabbr2
17357659	17357660	2.61	4.17	-2.96	0.000428	0.240307	Ms4a4b
17402222	17402241	4.68	6.26	-2.99	0.036656	0.607107	Abca4
17388371	17388381	5.21	6.8	-3.01	0.004352	0.37494	Mapk8ip1
	17388377	4.89	6.6	-3.26	0.026928	0.567666	
	17388376	6.22	8.17	-3.85	0.001319	0.303953	
17288677	17288678	3.43	5.02	-3.02	0.005814	0.399973	Pcsk1
17350925	17350930	3.47	5.07	-3.02	0.006008	0.403527	Iigp1
17427494	17427510	2.09	3.69	-3.04	0.04801	0.643234	Dock7
17502260	17502263	4.36	5.97	-3.04	0.011502	0.472424	Fam129c
17211347	17211354	3.31	4.93	-3.06	0.048379	0.64454	Tfap2b
17285097	17285123	4	5.63	-3.08	0.009895	0.455716	Dip2c
17287984	17288012	2.78	4.4	-3.08	0.009792	0.454734	Dapk1
17415136	17415137	3.17	4.8	-3.08	0.030162	0.584172	Adamtsl1
17493436	17493444	3.21	4.83	-3.08	0.047638	0.641744	1810020D17Rik
17387276	17387301	2.4	4.02	-3.09	0.014373	0.495353	Pde1a
17462492	17462497	2.92	4.55	-3.09	0.015935	0.507731	A2m
17493044	17493052	5.34	6.99	-3.13	0.017588	0.518834	Vmn2r66
17258041	17258044	4.34	5.99	-3.14	0.026457	0.565769	Dnaic2
17335952	17335959	2.79	4.43	-3.14	0.033919	0.597478	Cyp4f17
17475818	17475819	3.97	5.63	-3.16	0.019418	0.527495	LOC100302567
17544025	17544039	3.76	5.41	-3.16	0.021148	0.53614	Fndc3c1
17452430	17452445	2.26	3.93	-3.17	0.035911	0.604768	Ift81
17451400	17451405	3.64	5.31	-3.18	0.016575	0.51256	1700069L16Rik
17231252	17231262	4.65	6.32	-3.19	0.011243	0.470646	Camk1g
17401902	17401966	3.28	4.95	-3.19	0.005049	0.386255	Col11a1
17542899	17542912	4.9	6.58	-3.19	0.003933	0.369852	Prkx
17382059	17382070	2.87	4.55	-3.2	0.008569	0.436094	4921504E06Rik
17383052	17383101	3.33	5.02	-3.21	0.015992	0.508065	Notch1
17363016	17363019	3.46	5.15	-3.23	0.01035	0.461143	Oosp1
17481514	17481517	1.91	3.6	-3.23	0.047796	0.642451	Nlrp14
17543767	17543769	3.61	5.3	-3.24	0.004546	0.378259	4930519F16Rik
17408352	17408359	3.21	4.91	-3.25	0.03434	0.598949	Hsd3b1

17502816	17502819	2.65	4.35	-3.25	0.017951	0.520713	Inpp4b
17251179	17251198	2.95	4.66	-3.27	0.03757	0.610572	Myh13
	17251205	3.55	5.31	-3.38	0.01189	0.474794	
17411840	17411843	5.78	7.49	-3.28	0.000786	0.276874	Gem
	17411845	6.42	8.28	-3.63	4.39E-07	0.039515	
	17411847	7.32	9.72	-5.3	0.000174	0.203054	
	17411844	5.95	8.83	-7.35	0.000439	0.240307	
17479668	17479671	2.69	4.4	-3.28	0.028881	0.577592	Pde8a
17471296	17471303	2.96	4.69	-3.31	0.023685	0.552486	Tulp3
17284710	17284787	4.08	5.81	-3.32	0.020711	0.533673	Dnahc11
	17284718	5.23	7	-3.41	0.019672	0.528401	
17261778	17261801	5.25	6.98	-3.33	0.034676	0.599684	Odz2
17292499	17292501	2.87	4.61	-3.33	0.000379	0.236218	Gm8674
17265526	17265537	3.59	5.34	-3.35	0.014802	0.499041	Nlrp1c
17421242	17421243	2.56	4.32	-3.38	0.015934	0.507731	Gm13103
17344405	17344431	3.06	4.82	-3.39	0.038072	0.612136	Ddr1
17216942	17216944	4.15	5.92	-3.4	0.019731	0.528401	AA986860
17304012	17304045	3.45	5.24	-3.45	0.024402	0.555266	Kcnma1
17375718	17375731	3.5	5.29	-3.46	0.040273	0.619185	Usp8
17381475	17381501	3.63	5.42	-3.47	0.002643	0.335941	Celf2
17419131	17419150	3.99	5.78	-3.47	0.007014	0.415432	Col16a1
17455234	17455239	5.03	6.82	-3.47	0.00813	0.430586	Rnf6
17445193	17445205	3.19	5	-3.51	0.033242	0.595411	Pds5b
17465407	17465442	2.23	4.05	-3.52	0.034885	0.600366	Kcp
17251133	17251162	3.98	5.8	-3.53	0.03065	0.585561	Myh8
17367510	17367525	3.3	5.12	-3.54	0.012827	0.482669	Gad2
17448924	17448925	2.92	4.74	-3.54	0.006661	0.412569	Kdr
17254176	17254177	4.47	6.31	-3.57	0.016756	0.513794	Slfn4
17327524	17327529	4.53	6.37	-3.57	0.000396	0.236218	Igsf5
17381791	17381836	3.89	5.73	-3.57	0.015042	0.501471	Cubn
17532288	17532303	3.59	5.43	-3.57	0.038892	0.614921	Ulk4
17328000	17328037	6.17	8.01	-3.59	0.00029	0.228356	Usp7
	17328035	6.12	7.97	-3.61	0.004248	0.373895	
	17328036	5.54	9.64	-17.22	0.00003	0.140355	
17467965	17467966	2.96	4.8	-3.59	0.045175	0.634652	Reg3d
17317739	17317795	2.8	4.65	-3.6	0.009425	0.449274	Col22a1
17380044	17380055	4.32	6.17	-3.61	0.018369	0.523316	Gm16796
17231314	17231336	2.31	4.17	-3.62	0.023713	0.552715	Cr2
17402846	17402859	3.52	5.38	-3.62	0.023454	0.550828	Bdh2
17480420	17480424	2.72	4.58	-3.62	0.011433	0.472178	Pak1

17467840	17467846	3.05	4.91	-3.63	0.038703	0.61419	Dnahc6
17250829	17250835	3.32	5.18	-3.64	0.007312	0.418612	Tekt3
17304005	17304007	6.38	8.25	-3.64	0.002352	0.332021	Gm10248
	17304006	4.88	7.48	-6.06	0.014195	0.493902	
	17304008	6.82	9.55	-6.63	0.000156	0.192643	
17395718	17395726	3.25	5.12	-3.64	0.015813	0.506532	Chrna4
17503974	17504000	3.58	5.45	-3.65	0.004816	0.382194	Slc12a3
17391640	17391641	4.43	6.31	-3.68	0.011179	0.470088	Fam113a
17542149	17542154	3.09	4.97	-3.68	0.00697	0.415432	Ids
17356642	17356654	3.78	5.66	-3.69	0.015648	0.505578	Naaladl1
17352957	17352969	3.58	5.47	-3.71	0.044196	0.631789	Dsc1
17375454	17375465	3.66	5.59	-3.79	0.018117	0.52116	Slc28a2
17295960	17295962	2.57	4.5	-3.81	0.030963	0.586842	Cwc27
17310688	17310715	3.21	5.15	-3.83	0.00286	0.342191	Dnahc5
17401126	17401127	3.21	5.15	-3.84	0.003722	0.364033	Ampd1
17438530	17438556	3.03	4.99	-3.87	0.00686	0.414012	Lphn3
	17438535	3.13	5.68	-5.86	0.006721	0.413237	
17224629	17224642	3.14	5.11	-3.91	0.013905	0.49229	Obsl1
17522013	17522033	3.24	5.22	-3.92	0.003278	0.351301	Col7a1
17455028	17455042	4.26	6.23	-3.93	0.032686	0.594712	Kpna7
17485098	17485136	2.9	4.87	-3.94	0.03028	0.584227	Muc5b
17525894	17525897	2.86	4.83	-3.94	0.031431	0.5889	Sorl1
17272047	17272065	3.57	5.56	-3.99	0.011007	0.468698	Recql5
17436877	17436894	3.31	5.31	-3.99	0.018542	0.523949	Ablim2
17225413	17225454	3.22	5.23	-4.02	0.013883	0.492044	Col6a3
17421334	17421353	7.31	9.32	-4.02	0.011205	0.470441	Gm13242
17302889	17302913	3.18	5.2	-4.05	0.039338	0.616459	Pcca
17540282	17540301	4.6	6.62	-4.05	0.035106	0.601258	Med14
17346856	17346870	2.82	4.85	-4.07	0.046854	0.639206	Ptprm
17354599	17354600	3.13	5.18	-4.14	0.037303	0.60973	Myoz3
17205693	17205693	3.54	5.63	-4.25	0.011424	0.471929	
17518238	17518241	6.32	8.42	-4.28	0.001278	0.303953	Calml4
	17518242	4.95	7.75	-6.96	0.00079	0.277652	
	17518243	5.1	8.6	-11.32	0.001021	0.298219	
17525186	17525187	3.75	5.87	-4.33	0.014106	0.493601	Jam3
17372498	17372502	4.37	6.48	-4.34	0.032684	0.594712	Zc3h15
17223581	17223592	2.79	4.91	-4.35	0.013698	0.490416	Ica1l
17509617	17509620	2.75	4.89	-4.39	0.033129	0.595231	Cpe
17359239	17359247	3.74	5.88	-4.42	0.030658	0.585565	Cyp2c55
17291275	17291293	2.86	5.01	-4.43	0.01684	0.513974	Lrrc16a

17400914	17400921	3	5.15	-4.43	0.021247	0.536834	Spag17
17402607	17402622	2.9	5.06	-4.47	0.048744	0.646008	Col25a1
17273714	17273733	3.7	5.89	-4.58	0.04823	0.644063	Adcy3
17365098	17365101	3.76	5.96	-4.6	0.04242	0.626647	Scd1
17215885	17215888	4.39	6.63	-4.73	0.044382	0.632348	Agxt
17326711	17326724	3.98	6.24	-4.79	0.01315	0.485665	Cxadr
17491074	17491076	2.66	4.93	-4.82	0.010211	0.460656	Abcc8
17315272	17315287	2.08	4.37	-4.88	0.028303	0.574911	Tenc1
17482230	17482242	2.93	5.34	-5.3	0.010646	0.464161	Acsm5
17435055	17435087	2.23	4.64	-5.32	0.030902	0.5867	Pion
17463465	17463474	3.29	5.73	-5.43	0.001623	0.312252	Clec2g
17531327	17531330	3.04	5.56	-5.73	0.008909	0.440708	Fbxw14
17386514	17386517	3.55	6.13	-5.98	0.016536	0.512335	Gpr155
17399314	17399328	2.11	4.77	-6.3	0.028742	0.57692	Fam189b
17390530	17390535	2.48	5.27	-6.94	0.049373	0.647669	Strc
17281721	17281733	2.96	5.78	-7.04	0.008584	0.436496	Pygl
17430307	17430311	3.71	6.53	-7.09	0.041816	0.623514	Hpca
17370040	17370042	5.93	8.76	-7.12	0.00001	0.11246	
17532923	17532924	5.93	8.91	-7.9	0.000656	0.26885	Wdr45
17505345	17505362	2.2	5.28	-8.49	0.039541	0.616746	Pmfbp1
17548804	17548805	4.56	8.03	-11.1	0.000036	0.140355	Gm9429

Table S3: Pathway enrichment analysis using Gene Set Enrichment Analysis (GSEA) pathway signature C2_all_V4.0

NAME	SIZE	ES	NES	NOM p-val	FDR q-val	FWER p-val
MARZEC_IL2_SIGNALING_UP	109	0.58	2.27	<0.001	0.001	0.001
KAMIKUBO_MYELOID_CEBPA_NETWORK	27	0.75	2.25	<0.001	0.001	0.002
MANALO_HYPOXIA_DN	271	0.48	2.11	<0.001	0.016	0.042
SANA_RESPONSE_TO_IFNG_UP	55	0.60	2.11	<0.001	0.014	0.047
REACTOME_TRANSLATION	137	0.51	2.07	<0.001	0.020	0.082
REACTOME_PEPTIDE_CHAIN_ELONGATION	79	0.56	2.07	<0.001	0.018	0.088
KARLSSON_TGFB1_TARGETS_UP	119	0.52	2.07	<0.001	0.016	0.089
REACTOME_NUCLEOTIDE_BINDING_DOMAIN_LEUCINE_RICH_REPEAT_CONTAINING_RECEPTOR_NLR_SIGNALING_PATHWAYS	42	0.63	2.06	<0.001	0.015	0.097
KEGG_RIBOSOME	81	0.54	2.02	<0.001	0.025	0.178
NAGASHIMA_EGF_SIGNALING_UP	55	0.59	2.02	<0.001	0.023	0.179
REACTOME_3_UTR_MEDIATED_TRANSLATIONAL_REGULATION	98	0.53	2.02	<0.001	0.022	0.184
SUH_COEXPRESSED_WITH_ID1_AND_ID2_UP	18	0.74	2.01	<0.001	0.024	0.215
REACTOME_NONSENSE_MEDIATED_DECAY_ENHANCED_BY_THE_EXON_JUNCTION_COMPLEX	98	0.52	2.01	<0.001	0.022	0.219
REACTOME_METABOLISM_OF_RNA	240	0.46	1.99	<0.001	0.028	0.281
REACTOME_SRP_DEPENDENT_COTRANSLATIONAL_PROTEIN_TARGETING_TO_MEMBRANE	101	0.52	1.98	<0.001	0.028	0.300
REACTOME_INFLUENZA_VIRAL_RNA_TRANSCRIPTION_AND_REPLICATION	94	0.52	1.98	<0.001	0.028	0.313
LEE_AGING_NEOCORTEX_UP	81	0.53	1.97	<0.001	0.028	0.332
PID_IL3_PATHWAY	26	0.67	1.96	<0.001	0.028	0.394
SCHURINGA_STAT5A_TARGETS_UP	17	0.73	1.95	<0.001	0.032	0.427
REACTOME_INFLUENZA_LIFE_CYCLE	128	0.49	1.93	<0.001	0.035	0.503

Table S4: Pathway enrichment analysis using Gene Set Enrichment Analysis (GSEA) oncogene signature C6_all_V4.0

NAME	SIZE	ES	NES	NOM p-val	FDR q-val	FWER p-val
IL2_UP.V1_UP	164	0.52	2.13	<0.001	0.001	<0.001
IL15_UP.V1_UP	162	0.51	2.10	<0.001	0.001	<0.001
MYC_UP.V1_UP	149	0.47	1.92	<0.001	0.002	0.005
CSR_EARLY_UP.V1_UP	152	0.39	1.58	0.002	0.067	0.234
ESC_V6.5_UP_LATE.V1_DN	164	0.38	1.58	0.001	0.056	0.243
ESC_J1_UP_LATE.V1_DN	173	0.36	1.48	0.004	0.125	0.524
MTOR_UP.V1_UP	158	0.34	1.41	0.015	0.211	0.767
RPS14_DN.V1_DN	172	0.33	1.38	0.016	0.239	0.850
LTE2_UP.V1_DN	168	0.33	1.37	0.016	0.236	0.881
MEK_UP.V1_DN	162	0.31	1.30	0.038	0.391	0.981
WNT_UP.V1_DN	160	0.31	1.28	0.046	0.415	0.990
CYCLIN_D1_KE_.V1_UP	179	0.30	1.24	0.072	0.548	0.998
EGFR_UP.V1_UP	175	0.30	1.24	0.065	0.511	0.998
E2F1_UP.V1_UP	183	0.29	1.22	0.078	0.529	0.999
BCAT_BILD_ET_AL_UP	39	0.37	1.20	0.190	0.601	1
ESC_J1_UP_EARLY.V1_DN	163	0.29	1.18	0.119	0.629	1
E2F3_UP.V1_DN	115	0.30	1.18	0.154	0.620	1
IL21_UP.V1_UP	161	0.30	1.18	0.131	0.588	1
KRAS.600_UP.V1_UP	239	0.27	1.17	0.107	0.587	1
RB_DN.V1_DN	118	0.29	1.14	0.189	0.681	1

Figure S2: Heatmap for deregulated genes