

Mitochondrial DNA (mtDNA) haplogroups J and H are differentially associated with the methylation status of articular cartilage: potential role in apoptosis and metabolic and developmental processes

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ABSTRACT

Objective

To analyse the influence of mitochondrial genome variation on the DNA methylome of articular cartilage

Methods

DNA methylation profiling was performed from data deposited in the NCBI Gene Expression Omnibus (GEO) database (accession number GSE43269) consisted in the data of 14 haplogroup J cartilages and 20 H cartilages. Subsequent validation was performed in an independent subset of 7 haplogroup J cartilages and 9 H cartilages by RNA-seq. Correlated genes were validated by real-time PCR in an independent cohort of 12 J cartilages and 12 H cartilages. Appropriate analytical analyses were performed using R bioconductor and qBase plus software, and gene ontology analyses were conducted using DAVID v6.8

Results

DNA methylation profiling revealed 538 differentially methylated loci (DML) between H and J cartilages, whilst whole-transcriptome profiling identified 2384 differentially expressed genes between H and J cartilages. 17 genes showed an inverse correlation between methylation and expression. In terms of gene ontology, negative correlations between methylation and expression were also detected between H and J cartilages; highlighting a significantly enhanced and repressed apoptotic process in H and J cartilages respectively, as well as a significant enrichment of genes related to metabolic process and regulation of gene expression, in H cartilages, and to developmental process in J cartilages.

Conclusion

Mitochondrial DNA variation differentially associates with the methylation status of articular cartilage by acting on key mechanisms involved in OA, such as apoptosis, metabolic and developmental processes.

INTRODUCTION

Osteoarthritis (OA) is a chronic progressive disorder that involves movable joints and is characterised by cell stress and extracellular matrix degradation initiated by micro- and macro-injuries that activate maladaptive repair responses including pro-inflammatory pathways of innate immunity. The disease manifests first as a molecular derangement (abnormal tissue metabolism) followed by anatomical and/or physiological derangements (characterised by cartilage degradation, bone remodelling, osteophyte formation, joint inflammation and loss of normal joint function) that can culminate in illness (1). OA is a heterogeneous disease, with a combination of modifiable factors, such as body mass index or joint injury, and non-modifiable factors like age, gender or genetics.

In recent years, the study of epigenetics in OA attracted increasing interest. The term epigenetics refers to heritable changes in gene expression without changes in the DNA sequence, either by affecting gene transcription or by acting post-transcriptionally. Among the best characterized epigenetic mechanisms, DNA methylation stand out. It has been proposed that DNA methylation is involved in the phenotypic modulation that articular chondrocytes experience during the development of OA, leading to an over-expression of cartilage-degrading enzymes and inflammatory mediators, breaking the homeostatic balance towards extracellular matrix degradation and playing a decisive role in the progression of the disease (2, 3).

Initial DNA methylation studies in OA were based on the study of specific CpG sites within the promoter region of OA-related genes, mainly cartilage-degrading enzymes (2, 4-7). More recently, genome-wide DNA methylation analyses in OA have also been performed. These studies included the analysis of the methylome of cartilage/chondrocyte, the subchondral bone as well as human mesenchymal stem cells (hMSCs) from femoral heads of patients with hip fractures (8). From these studies, interesting conclusions can be drawn; on the one hand, hip and knee cartilage show different DNA methylomes (9) and even OA patients with the same affected joint can have different methylomes too; more specifically, a subgroup of OA patients with altered methylome in inflammation-related genes was independently identified (9, 10). On the other hand, the presence of an epigenetic phenotype associated with eroded OA subchondral bone similar to that of overlying eroded OA cartilage was also suggested (11), and hMSCs from OA patients with hip fractures showed accelerated methylation aging and enhanced proliferation of the osteogenic drivers RUNX2/OSX (12). Altogether, these works evidence the complexity of OA that includes complex genetic-epigenetic interactions and therefore further efforts must be done in order to clarify the role played by epigenetics in this disease (13).

Mitochondria and the mitochondrial DNA (mtDNA) haplogroups play a role in the pathogenesis of OA (14). Specifically, the mtDNA haplogroups influence the prevalence of OA in different geographic populations (15-17) as well as the radiographic progression and

cartilage integrity over time in patients of the progression subcohort of the Osteoarthritis Initiative (18, 19). A recent meta-analysis involving more than 3000 subjects concluded that mtDNA haplogroups significantly influence the rate of incident knee OA; specifically, those subjects harboring haplogroup J show a significant decreased risk of developing incident knee OA at 8 years compared with subjects harboring haplogroup H, a different haplogroup in terms of ROS and ATP production, mitochondrial metabolism and apoptosis (20).

The function of the mitochondria is controlled by the nucleus by means of an “anterograde regulation”, a mechanism that regulates both mitochondrial biogenesis and activity to meet the needs of the cell; on the other hand, mitochondria and mtDNA variation maintain partial regulatory signaling control over the nuclear epigenome, modulating the expression of nuclear genes through a “retrograde regulation”, a response signaling mechanism that leads to the modification of cellular function by reprogramming its metabolism (21, 22). The role of this bidirectional communication between nucleus and mitochondrion is not only to maintain cellular homeostasis, but also regulate the adaptation to a wide range of stressors (23).

In the light of these evidences and, given the demonstrated role of the mitochondria and mtDNA variation in OA, in this study we analyze the methylation data of cartilage samples carrying the mtDNA haplogroups H and J from our previously published genome-wide methylation assay (10) in order to check the influence of the mtDNA haplogroups on the DNA methylome of articular cartilage.

MATERIALS AND METHODS

DNA methylation profiling. DNA methylation profiling was performed using previous methylation raw data deposited in the NCBI Gene Expression Omnibus (GEO) database (<http://www.ncbi.nlm.nih.gov/geo/>), with accession number GSE43269 (10). These data were obtained using the Infinium HumanMethylation27 beadchip (Illumina, San Diego, CA, USA), which allows interrogation of 27,578 highly informative CpG sites located within the proximal promoter regions of 14,495 genes and 110 microRNAs. We collected the methylation data from 14 J cartilage samples and 20 H (Table 1) to subsequently perform the appropriate differential analyses between these two haplogroups.

Data filtering, normalization and analysis of methylation data. The detection p-values measure the difference in signal intensities between the interrogated CpG site and those from a set of 16 negative control probes embedded in the assay. Therefore, those samples with a detection p-value greater than 0.05 in more than 25% of all probes were considered as not significantly different from background noise, and removed from subsequent analyses as an extra quality control measure. Besides, those probes that were designed for sequences on X and Y chromosomes were also excluded.

We used M-value defined by *Lumi* and *Methylumi* package (R, Bioconductor) for differentially methylated analysis between mtDNA haplogroups H and J. M-value, which is the \log_2 ratio of methylated probe intensity and unmethylated probe intensity, is a method used to

measure the methylation levels and is homoscedastic in the entire methylation range, therefore being more statistically valid in differential and other statistical analysis (24, 25).

As a result of data filtering, one sample carrying the mtDNA haplogroup J obtained a detection p-value > 0.05 in more than 25% of all probes, being consequently removed from further analyses.

Differentially methylated (DM) sites among mtDNA haplogroups. Statistical analysis and data visualization were carried out using the R/Biocoductor software packages (<http://www.bioconductor.org>). DNA methylation M-values of selected probes were compared among mtDNA haplogroups using ANOVA (Analysis of Variance) with *Multcomp* package. The analysis was adjusted for confounder effects of age, gender and disease status. As a consequence, to prevent the increase of type I error, Bonferroni correction was used to analyze specific haplogroup differences between H and J variants (26). CpGs sites were considered significantly differentially methylated if Bonferroni adjusted p-value was below 0.05.

The Illumina Infinium DNA methylation β -values were represented graphically using heatmaps generated by the R/Bioconductor packages heatmap and Heatplus.

RNA-seq. Knee cartilage samples for gene expression through RNA-seq (Table 1) were obtained from Hospital Universitario A Coruña. OA and healthy cartilages were obtained from autopsies or leg amputations, showing a microscopic Mankin score > 7 and < 2.5 respectively. All cartilage samples were collected from the central area

of the tibial plateau of the knees, and represent a mixture of superficial, intermediate and deep layers of the articular cartilage. Informed consent was obtained from all participants in compliance with the Helsinki declaration, and this study was approved by ethics committee of Galicia.

The whole RNA-seq process was carried out at Progenika Biopharma facilities (www.progenika.com). Genome-wide transcriptomic analysis was performed in a set of 7 haplogroup J cartilage samples and 9 haplogroup H cartilage samples (Table 1). For RNA isolation, cartilage samples (50-70 mg) were disrupted using a mortar, after freezing in liquid nitrogen before using the RNeasy Mini Kit (Qiagen, Duesseldorf, Germany) following manufacturer recommendations. RNA concentration was assessed using Nanodrop ND-1000 spectrophotometer (Thermo Scientific, Wilmington, DE) and RNA quality was determined with the Agilent 2100 Bioanalyzer (Agilent, Santa Clara, CA).

Sequencing cDNA libraries were prepared from 30 ng RNA using Ovation Universal RNA-seq System 1-16 and Ovation Universal RNA-seq Adaptor Module 1-16 (NuGen, San Carlos, CA) following manufacturer recommendations. The quality of the obtained cDNA library was then checked with both Qubit (Invitrogen, ThermoFisher, Wilmington, DE) and Agilent 2100 Bioanalyzer (Agilent, Santa Clara, CA) using the High Sensitivity DNA Analysis kit.

After the generation of the clusters inside the flow cell, a high density of molecules/cm² on each cluster was subsequently generated;

therefore the samples were then sequenced in an Illumina HiSeq 4000 .

Differential analysis of RNA-seq data. Classically, the analysis of RNA-seq data includes the alignment of the obtained reads to a reference transcriptome followed by the quantification of the different transcripts. In this work we used the *Kallisto* method (27), and the RNA-seq reads were mapped to the reference genome GRCh38 version 88 located in Ensembl server (www.ensembl.org). All the reads were previously analysed with FastQC package (www.bioinformatics.berabaham.ac.uk/projects/fastqc) in order to perform the pre-treatment and to check the quality control.

To quantify the abundance of a transcript at genetic level we used *Tximport* package (28) included in R Bioconductor software (<https://cran.r-project.org>), using “transcripts per million” (TPM) as a quantification unit. Differential expression analyses between haplogroups H and J were performed following the *limma-voom* method (29) included in R Bioconductor software. A model including the haplogroup, as independent variable, and diagnosis, gender and age as covariables, was performed to detect the differentially expressed genes between haplogroups H and J.

Genes with a Benjamini-Hochberg (B-H) adjusted p-value <0.05 were considered significantly differentially expressed between haplogroups H and J. Differentially expressed genes were visualized using volcano plots and heatmaps.

To identify the overlapped genes with inverse correlation between methylation and expression we crossed the significant genes

and DMLs of both assays, as described in other studies (30).

Gene ontology (GO) analyses. Functional characteristics consisting in an overrepresentation analysis of the GO categories which appeared significantly enriched in the selected lists of the differentially methylated/expressed genes between mtDNA haplogroups J and H were examined using DAVID (Database for Annotation, Visualization and Integrated Discovery) v6.8 (<https://david.ncifcrf.gov/>) bioinformatics database functional tool (31).

Real time-PCR validation. The expression levels of those genes in which an inverse relationship between methylation and expression was detected were subsequently analysed in knee cartilages from the central area of the tibial plateau (representing a mixture of superficial, intermediate and deep layers of the articular cartilage) belonging to an independent subset of 24 OA patients (12 haplogroup J and 12 haplogroup H cartilages) from the same cohort (Table 1) using a Lightcycler 480 II real time PCR system (Roche, Basel, Switzerland). The gene Beta-2 microglobulin (B2M) was used as a constitutive gene. The data analysis was carried out using qBase plus software (Biogazelle, Ghent University, Belgium).

RESULTS

DNA methylation pattern in mtDNA haplogroups. The post-hoc Bonferroni analysis revealed 538 DMLs between haplogroups H and J (Figure 1a) after adjusting for gender, age and disease status; of these, 451 were more methylated in J and 87 were less methylated in J in relation to the most common haplogroup H (Supplementary Table 1). A CpG site of fucosidase, alpha-L-1 (FUCA1) gene was the most differentially hypermethylated CpG, whilst the CpG site of homeobox D3 (HOXD3) gene was the most differentially hypomethylated CpG in cartilages carrying the haplogroup J compared with cartilages carrying the most common haplogroup H.

The location of a CpG has important implications on its effect on gene expression; therefore we additionally explored the genomic location of the DMLs attending to the chromatin states described in the Roadmap Epigenomics Consortium (32). Most of the significant DMLs belong to active transcription start sites (TSS) (58.4%) or regions flanking active TSS (21.6%) and only 1.12% belong to enhancer regions (Supplementary Figure 1). Of them, the CpG site located in a region flanking the active TSS of FUCA-1 gene was, again, the most differentially hypermethylated CpG in carriers of the mtDNA J in relation to H; on the contrary, a CpG site located in the enhancer region of the RNASE8 gene was the most differentially hypomethylated CpG in carriers of the mtDNA haplogroup J in relation to H (Table 2).

When the gene ontology (GO) analysis was performed, the biological processes associated with significantly hypomethylated

genes in haplogroup J cartilages in relation to H were those related to the negative regulation of both the apoptosis ($p=0.021$) and the catalytic activity ($p=0.035$) as well as the developmental process ($p=0.015$); whilst the altered processes related to significantly hypomethylated genes in haplogroup H cartilages in relation to J were mainly those involved in cell death ($p=0.010$), the positive regulation of apoptosis ($p=0.007$), protein transport ($p=0.007$), metabolic processes ($p=1.93e-4$) as well as the regulation of cellular processes ($p=0.009$) and gene expression ($p=0.012$). In terms of molecular function, significantly hypomethylated CpGs in haplogroup J cartilages in relation to H were detected in genes related to the activity of transcription factors ($p=0.019$); on the contrary, the significantly hypomethylated CpGs in haplogroup H cartilages, in relation to J, were mainly those detected in genes related to nucleotide and metal ion binding ($p=0.001$ and $p=0.043$ respectively) (Figure 1b and 1c).

Among the DMLs involved in the differential regulation of apoptosis between H and J variants, those contained in DnaJ Heat Shock Protein Family (Hsp40) Member A3 (DNAJA3), nuclear factor of kappa light polypeptide gene enhancer in B-cells 1 (NF κ B1) or cyclin-dependent kinase inhibitor 2D (CDKN2B) genes appeared hypomethylated in J cartilages in relation to H; whilst those DMLs contained in janus kinase 2 (JAK2), lymphotysin alpha tumor necrosis factor superfamily, member 1 (LTA), ubiquitin B (UBB), complement component 9 (C9), insulin-like growth factor binding protein 3 (IGFBP3), tumor necrosis factor receptor-associated factor 3 (TRAF3) or Second

Mitochondria-Derived Activator Of Caspase (DIABLO) genes appeared hypomethylated in H cartilages in relation to J.

Whole-transcriptome analysis. Preliminary quality analyses lead to the removal of one of the samples; therefore the remaining 15 were subjected to subsequent analyses. For the differential expression analysis, a total of 16,827 genes, with at least 1 TPM in 40% of the samples, were considered.

The results obtained showed a total of 2384 differentially expressed genes between haplogroup H and J cartilages (Figure 2a and 2b), of which 2030 were significantly overexpressed in haplogroup J cartilages in relation to H, and 354 were significantly overexpressed in haplogroup H cartilages in relation to J (Supplementary Table 2).

The most differentially expressed genes between haplogroups H and J were FosB proto-oncogene, AP-1 transcription factor subunit (FOSB) gene and sodium Channel Protein Type 5 Subunit Alpha (SCN5A) gene; these genes appeared overexpressed in H cartilages and J cartilages respectively (Supplementary Table 2).

The GO analysis revealed differentially expressed processes, molecular functions and cellular components depending on the haplogroups (Figure 2c and 2d). In relation to J, H cartilages showed a significantly increased amount of genes related to nuclear part ($p=4.61e-10$) and membrane-enclosed lumen ($p=1.85e-9$); whilst in J cartilages, a significant enrichment of genes related to intrinsic component of membrane were over-expressed ($p=1.67e-38$). In terms of molecular functions, both haplogroups showed a differential profile; H

cartilages showed increased transcriptional repressor ($p=0.027$) and transcription factor activities ($p=0.045$), whilst J cartilages revealed an enrichment of genes related to ion transmembrane transporter activity ($p=2.99e-4$), mainly Calcium ($p=6.81e-24$). In relation to differentially altered biological processes, H cartilages showed an enrichment of over-expressed genes involved in RNA metabolic process ($p=7.44e-5$), mRNA splicing ($p=3.89e-4$) and gene expression, as well as metabolic process ($p=6.79e-4$) and, interestingly, cell death ($p=0.019$); conversely, J cartilages showed an enrichment of genes related to chemical synaptic transmission ($p=1.56e-27$), transmembrane transport ($p=1.85e-22$), especially Calcium ($3.17e-4$) and Potassium ($p=1.62e-10$) transport; as well as developmental process ($p=8.25e-12$).

In terms of relationships between methylation and expression, we detected a total of 46 overlapped genes between these two assays. Of these, 17 genes showed an inverse correlation between the two approaches, being 10 hypomethylated and up-regulated in haplogroup J cartilages in relation to H, whilst 7 were hypermethylated and down-regulated in haplogroup J cartilages in relation to H (Table 2). The remainder 29 genes showed a direct correlation between methylation and expression.

Real time-PCR validation. We validated, in an independent subset of 12 knee OA J cartilages and 12 knee OA H cartilages, the 17 genes with inverse correlation between methylation and expression data (Table 2).

Of all the 17 genes analysed, 6 showed no amplification in any of the samples. Of the remaining 11 genes, ATXN7 appeared significantly up-regulated ($p=0.023$) in haplogroup H cartilages compared with haplogroup J cartilages (Table 3).

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DISCUSSION

In the present study, we compared for the first time the DNA methylome of articular cartilages harbouring mtDNA haplogroups J and H, followed by a whole-genome transcriptome analysis by means of RNA-seq and subsequent real-time PCR validation of correlated genes. The results obtained show not only a differential methylation profile related to these haplogroups, but also correlations between methylation and expression in terms of gene ontology, such as apoptosis, developmental process, metabolic process or the regulation of gene expression. In terms of genes, a total of 17 showed an inverse correlation between methylation and expression.

Cartilages harbouring haplogroups J and H show a differential behaviour in terms of apoptosis, being this process enhanced in H cartilages and more repressed in J cartilages. Moreover, H cartilages also show an enrichment of overexpressed genes related to cell death. The relationship between mtDNA haplogroups and apoptosis is not new; a study by Kenney and co-authors showed that cybrids with haplogroup J had reduced expression of apoptosis-related genes than cybrids with haplogroup H (33). In addition, J cybrids also show a lower grade of apoptosis under stress conditions as well as a lower expression of the apoptotic gene BBC3 when compared with H cybrids (20). Altogether, these results evidence that inherited mitochondrial variants can affect apoptosis pathway and, since chondrocyte death is a central feature in OA progression (34, 35), this could explain, at least in

part, the associations of haplogroup J with the lower rate of knee and hip OA prevalence and incident knee OA (20, 36, 37).

In this study a significant enrichment of both overexpressed genes and hypomethylated CpGs of genes related to developmental process, including the homeobox family of transcription factor genes, was also detected in J cartilages in relation to H cartilages. These genes have been shown to play a key role in the regulation of embryonic development, morphogenesis, cellular proliferation and differentiation, and angiogenesis. A potential link between OA and homeobox transcription factors has been previously proposed (38) and, interestingly, genome-wide methylation studies performed in OA cartilage showed these kind of genes with altered methylation profile (9, 10, 39). As for rs225014 and rs12885300 polymorphisms in DIO2 gene, a key regulator gene of the endochondral ossification process and whose relationship with OA pathology relies on its influence on skeletal formation (40), the findings of the present study could point to the importance of mitochondria in the developmental process, including cell differentiation, skeletal embryogenesis and even joint morphology, through the influence of mitochondrial genetic background on the methylation and expression patterns of this family of genes. Specifically, joint morphology is considered a relevant risk factor for OA development and progression (41), and differential expression of genes involved in skeletal formation was also found in OA affected cartilage (42).

In terms of fold change, real time PCR validation showed that a total of 6 out of the 7 genes with inverse correlation between methylation and expression in haplogroup H cartilages were over-expressed in this haplogroup; however, only ATXN7 (Ataxin 7) reached the statistical significance. ATXN7 is a transcription factor that appears to be critically important for chromatin remodelling at the level of histone acetylation and deubiquitination. This gene is involved in the development of spinocerebellar ataxia, a neurodegenerative disorder, although its role in OA is not known and requires further investigation. However, since this gene has been proposed to be involved in the mitochondrial apoptotic pathway through the activation of caspases -3 and, more specifically -9 (43, 44), from these data would be conceivable that cartilages harbouring mtDNA haplogroup J are less prone to activate this pathway, in agreement with previous studies mentioned above in this manuscript.

Mitochondria exert a retrograde control over the nucleus through a series of signalling mechanisms that modify nuclear gene expression, leading to different compensatory mechanisms (45). The compensatory mechanisms may be induced in response to either mitochondrial dysfunction or mtDNA inherited variants (haplogroups), which are capable of alter the crosstalk signalling between the mitochondria and the nucleus, inducing nuclear compensation in the form of altering DNA methylation patterns and therefore gene expression (21). In agreement with this, not only are the results described in this work, but also other findings. Cybrids harbouring haplogroup J show increased levels of

global DNA methylation as compared with other mtDNA variants (46); in addition, both H and J haplogroups differentially mediate methylation profiles and transcription for inflammation and angiogenesis (47); and mouse embryonic stem cells containing different mtDNA haplogroups on a uniform nuclear background were associated with different gene expression and DNA methylation profiles (48).

In relation to the underlying mechanisms by which mitochondrial variation promote modifications in the methylome, it is conceivable that mitochondrial reactive oxygen species (ROS), small RNAs, mitochondria-derived peptides or reactive metabolic intermediates from the mitochondrial metabolism represent important retrograde signaling stimulus for nuclear epigenomic DNA modifications (21, 49, 50). Taken together, the findings provided in this work support the evidence of the mitochondrial genome as an epigenetic regulator of the nuclear genome in articular cartilage.

For this study we did not set a minimum differentially-expressed/methylated ratio threshold, but we selected those loci with adjusted statistical significance, as described in other studies (30, 51). The methylation data have been obtained from an ancient array (Illumina HumanMethylation27 beadchip), that showed small significant methylation differences between haplogroups H and J. To what extent these differences are sufficient to induce changes in the expression pattern, it could be assessed by making the corresponding expression assay. In addition, it must be noted that other potential DMLs not included in this array could also contribute to induce changes in the

expression pattern. In this sense, the use of three different independent subsets of samples allowed us to detect 17 overlapping genes with an inverse correlation between methylation and expression, being one of them (ATXN7) statistically validated by real time PCR. This is interesting and contributes robustness to the study because it must be noted that not only the mitochondrial genome has the potential to induce changes in the methylation/transcription pattern of articular chondrocytes, but also other intrinsic factors related to the nature of the articular cartilage as well as the condition or state of the OA disease, even in terms of overlapped phenotypes, could also affect (9, 10, 52).

In summary, it is well established that mitochondrial function is vital to provide the intermediate metabolites necessary to generate epigenetic marks, including DNA methylation, in the nucleus (22). In this sense, two biochemically different mtDNA haplogroups, such as J and H (53, 54), are differentially associated with the methylation status of articular cartilage. We could hypothesize that the epigenetic modification that takes place in OA that affects key-related features, such as apoptosis or metabolic alterations, is different depending on the haplogroup. This could determine, to some extent, the evolution of the disease.

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FIGURE LEGENDS

Figure 1. Hierarchical analysis and potentially altered biological processes (GO) of the differentially methylation loci (DML) between haplogroup J and haplogroup H cartilages. **a)** Heatmap showing the 538 DMLs between haplogroup J cartilages and haplogroup H cartilages; **b)** GO analysis comparing the hypomethylated genes in haplogroup J cartilages related to haplogroup H cartilages; **c)** GO analysis comparing the hypomethylated genes in haplogroup H cartilages related to haplogroup J cartilages. ES: Enrichment Score. (** $p \leq 0.0001$; ** $p \leq 0.01$; * $p \leq 0.05$)

Figure 2. Hierarchical analysis and potentially altered biological processes (GO) of the differentially expressed genes between haplogroup J and haplogroup H cartilages. **a)** Volcano plot showing the differentially expressed genes between haplogroups H and J. Blue dots are over-expressed in H versus J, and red dots are genes over-expressed in J versus H. **b)** Heatmap showing the 2384 differentially expressed genes between haplogroup J cartilages and haplogroup H cartilages; **c)** GO analysis comparing the over-expressed genes in haplogroup J cartilages related to haplogroup H; **d)** GO analysis comparing the over-expressed genes in haplogroup H cartilages related to haplogroup J. ES: Enrichment Score. (** $p \leq 0.0001$; ** $p \leq 0.01$; * $p \leq 0.05$)

Supplementary figure 1. Genomic location of DMLs between haplogroups H and J. Percentage of DMLs between haplogroups H and J on each of the genomic locations attending to the chromatin states described in the Roadmap Epigenomics Consortium. TssA: Active transcription start site; TssAFlnk: Transcription at gene 5' and 3'; TxFlnk: Strong transcription; TxWk: Weak transcription; Enh: Enhancers; TssBiv: Bivalent/Poised transcription start site; BivFlnk: Flanking bivalent Tss/Enh; ReprPC: Repressed PolyComb; ReprPCWk: Weak repressed PolyComb; Quies: Quiescent/low

Table 1. Characteristics of the study population

Cohort	N	Mean age \pm SD	%Gender (Female/Male)	Disease status (OA/Healthy)
<i>Methylation cohort</i>	34			
Haplogroup H	20	67.1 \pm 9.9	9 (45) / 11 (55)	12 (60) / 8 (40)
Haplogroup J	14	62.8 \pm 9.5	7 (50) / 7 (50)	6 (42.9) / 8 (57.1)
<i>RNA-seq cohort</i>	16			
Haplogroup H	9	66.1 \pm 17.8	4 (44.5) / 5 (55.5)	5 (55.5) / 4 (44.5)
Haplogroup J	7	71.8 \pm 11.3	3 (43) / 4 (57)	5 (71) / 2 (29)
<i>Real-time PCR cohort</i>	24			
Haplogroup H	12	69.9 \pm 9.4	8 (66.6) / 4 (33.3)	12 (100) / 0 (0)
Haplogroup J	12	69.6 \pm 6.3	6 (50) / 6 (50)	12 (100) / 0 (0)

Values represent frequencies with percentage in parentheses; SD = standard deviation; OA: osteoarthritic patients

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Table 2. List of the 17 significant altered genes with inverse correlation between methylation and expression and associated biological processes

Biological processes enriched in haplogroup H cartilages						Biological processes enriched in haplogroup J cartilages					
GENE SYMBOL	Mean β -value difference (H - J)	adj. p-value methylation*	Log.Fc (J vs H)	adj. p-value expression#	Biological process	GENE SYMBOL	Mean β -value difference (H - J)	adj. p-value methylation*	Log.Fc (J vs H)	adj. p-value expression#	Biological process
AGL	-0.0078	0.02027	-1.5453	0.04199	Metabolic process, Metal Ion binding	ACE	0.0036	0.03551	4.5218	0.00122	Developmental process
ATXN7	-0.0096	0.04938	-1.4136	0.01058	Cell death, Metabolic process, Regulation of gene expression, Metal Ion binding, Cellular process	ADCY4	0.0044	0.04823	2.4765	0.01760	Negative regulation of catalytic activity
FPGS	-0.0051	0.00230	-1.1650	0.04580	Metabolic process, Nucleotide binding	EMX1	0.0047	0.04861	4.9444	0.00261	Developmental process, Transcription factor activity
GPR89B	-0.0049	0.02138	-1.4849	0.04599	Cellular process	GDNF	0.0117	0.04760	2.7488	0.04211	Developmental process, Cell communication
MCCC2	-0.0237	0.02628	-1.2505	0.04015	Metabolic process, Nucleotide binding	GP2	0.0411	0.03345	2.7910	0.02197	Innate immune response, Antigen-binding
PPME1	-0.0047	0.03481	-1.2707	0.04480	Metabolic process	INSL6	0.0715	0.03694	2.5185	0.00393	Developmental process
USP13	-0.0041	0.00902	-1.2209	0.02099	Metabolic process, Regulation of gene expression, Metal Ion binding	KCNIP4	0.0063	0.03051	4.0660	0.00993	Metal Ion binding, Calcium Ion binding, Cell communication
						MMP8	0.0227	0.02569	3.9680	0.00811	Developmental process
						OTOA	0.0516	0.00246	3.7502	0.00248	Developmental process, Cell communication
						WT1	0.0151	0.04113	3.9396	0.03872	Developmental process, Transcription factor activity, Ion binding

(*) adjusted p-value calculated by Bonferroni method for false discovery rate control; (#) adjusted p-value calculated by Benjamini & Hochberg's method for false discovery rate control; LogFc: log fold change

Table 3. Mean expression levels of 11* genes with inverse correlation between methylation and expression in the real-time PCR cohort between 12 haplogroup J cartilages and 12 haplogroup H cartilages

Expected overexpressed genes in haplogroup H in relation to J					Expected overexpressed genes in haplogroup J in relation to H				
GENE SYMBOL	Mean expression ratio H/J	95% value CI low	95% value CI high	p-value	GENE SYMBOL	Mean expression ratio H/J	95% value CI low	95% value CI high	p-value
AGL	1.429	0.615	3.321	0.335	ACE	0.348	0.072	1.680	0.054
ATXN7	2.373	0.977	5.766	0.023[#]	ADCY4	1.384	0.477	4.019	0.464
FPGS	1.403	0.544	3.616	0.295	GDNF	1.105	0.146	8.380	0.304
MCCC2	1.413	0.530	3.770	0.221	INSL6	1.505	0.219	10.356	0.315
PPME1	1.215	0.636	2.321	0.511	MMP8	1.560	0.219	11.107	0.276
USP13	1.229	0.638	2.368	0.295					

(*) Only those genes with positive real-time amplification (11/17) are shown; ([#]) p-value \leq 0.05 after Mann-Whitney non-parametric test; CI: confidence interval.

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Author's contribution

FJB and IRP contributed equally in the design and coordination of the study; both conceived the study, participated in its design and helped to draft the final version of the manuscript; ECP and JFT contributed equally in the statistical analysis of methylation and transcriptomic data; MFM and MVM helped in the performing of the real-time PCR experiments; PRL and SR carried out the cartilage sample obtaining and the subsequent RNA isolation for real-time PCR experiments; ADS and ADF carried out the experimental procedures of mitochondrial haplogroup assignment; NOV coordinated the access to the biological samples used in this study. All the authors approved the final version of the manuscript.

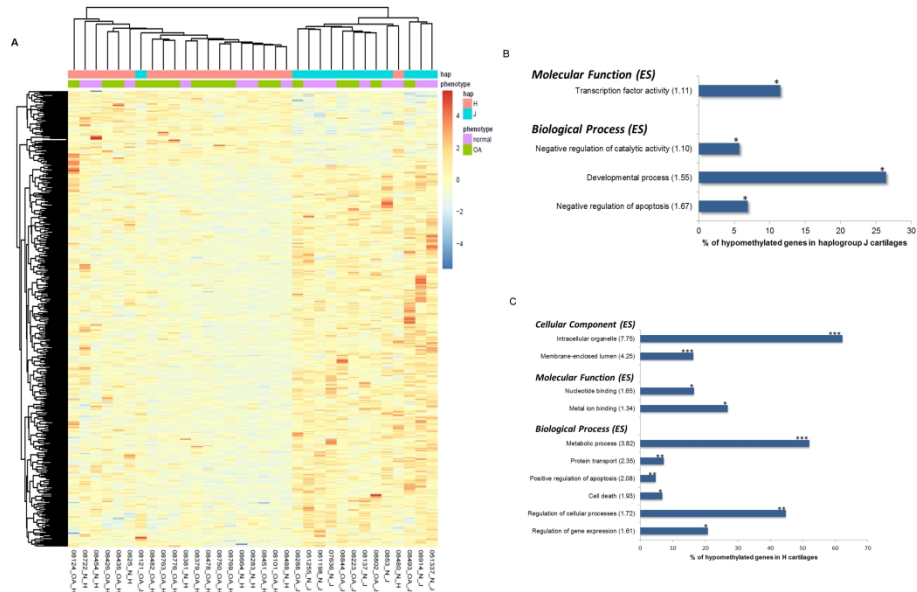


Figure 1. Hierarchical analysis and potentially altered biological processes (GO) of the differentially methylation loci (DML) between haplogroup J and haplogroup H cartilages. a) Heatmap showing the 538 DMLs between haplogroup J cartilages and haplogroup H cartilages; b) GO analysis comparing the hypomethylated genes in haplogroup J cartilages related to haplogroup H cartilages; c) GO analysis comparing the hypomethylated genes in haplogroup H cartilages related to haplogroup J cartilages. ES: Enrichment Score. (** $p \leq 0.0001$; ** $p \leq 0.01$; * $p \leq 0.05$)

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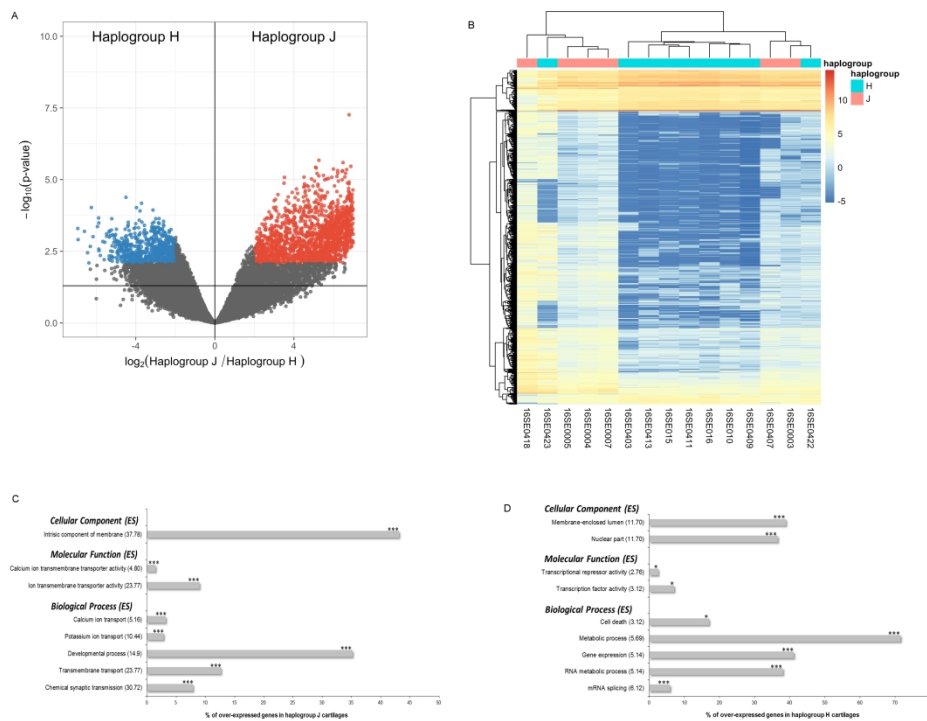


Figure 2. Hierarchical analysis and potentially altered biological processes (GO) of the differentially expressed genes between haplogroup J and haplogroup H cartilages. a) Volcano plot showing the differentially expressed genes between haplogroups H and J. Blue dots are over-expressed in H versus J, and red dots are genes over-expressed in J versus H. b) Heatmap showing the 2384 differentially expressed genes between haplogroup J cartilages and haplogroup H cartilages; c) GO analysis comparing the over-expressed genes in haplogroup J cartilages related to haplogroup H; d) GO analysis comparing the over-expressed genes in haplogroup H cartilages related to haplogroup J. ES: Enrichment Score. (** $p \leq 0.0001$; ** $p \leq 0.01$; * $p \leq 0.05$)

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S1 Table. Significant DMLs between mtDNA haplogroups J and H sorted by decreased mean differences in β -values

Increased methylation in mtDNA haplogroup J in relation to H						Decreased methylation in mtDNA haplogroup J in relation to J					
GENE SYMBOL	adj. p-value	Mean β -value in haplogroup J	Mean β -value in haplogroup H	Mean difference (H - J)	Genomic región	GENE SYMBOL	adj. p-value	Mean β -value in haplogroup J	Mean β -value in haplogroup H	Mean difference (H - J)	Genomic región
FUCA1	0.02777601	0.399312696	0.280808728	-0.118504	TssAFlnk	HOXD3	0.00972604	0.598486681	0.702065414	0.10357873	ReprPC
SCGB3A2	0.0389597	0.463906683	0.376409848	-0.0874968	ReprPCWk	C18orf22	0.0122295	0.44752513	0.540030453	0.09250532	TssAFlnk
BATF	0.0193415	0.400475125	0.313485669	-0.0869895	TssA	RNASE8	0.01712879	0.4710678	0.563567625	0.09249982	Enh
SMAD9	0.02008177	0.652007037	0.569444743	-0.0825623	TxWk	PXT1	0.01977422	0.480545025	0.560498861	0.07995384	Quies
PARG	0.0368257	0.51949802	0.440874968	-0.0786231	TxWk	TMEM85	0.02167335	0.263073523	0.341621104	0.07854758	TssAFlnk
RP11-631M21.2	0.04585799	0.661697616	0.586322251	-0.0753754	ReprPC	CUEDC1	0.00603239	0.756111604	0.827769409	0.07165781	TxWk
MAP3K7IP1	0.0021723	0.690737633	0.615472567	-0.0752651	Quies	INSL6	0.03693925	0.670885926	0.742421783	0.07153586	ReprPCWk
CHRN3	0.04619031	0.532840034	0.458801353	-0.0740387	ReprPCWk	PARK2	0.02279648	0.562938798	0.62636458	0.06342578	ReprPCWk
C4orf50	0.04658875	0.258153918	0.185906253	-0.0722477	Quies	TCP11	0.00026284	0.730426317	0.786807024	0.05638071	TxWk
MT2A	0.04679405	0.252876945	0.182187135	-0.0706898	TssAFlnk	KCNN4	0.03873873	0.626915659	0.682008441	0.05509278	TxWk
GPR132	0.02500337	0.463643694	0.39315051	-0.0704932	Enh	OTOA	0.00245835	0.631505306	0.683112724	0.05160742	ReprPCWk
JAK2	0.00504873	0.538640289	0.471831859	-0.0668084	TssAFlnk	BTN3A2	0.04987696	0.637554195	0.68909609	0.0515419	TssAFlnk
MLLT6	0.0100727	0.177538577	0.11748274	-0.0600558	TssAFlnk	RGSL1	0.04670961	0.73047679	0.781064602	0.05058781	ReprPCWk
MCCC1	0.04127632	0.20903379	0.150586743	-0.058447	TssA	OR51B4	0.02404552	0.623224522	0.671966061	0.04874154	Quies
CIAO1	0.03075463	0.412039967	0.354504713	-0.0575353	TssAFlnk	FHIT	0.04774361	0.137109412	0.18496194	0.04785253	TssA
EI24	0.00242219	0.141169571	0.086879903	-0.0542897	TssA	HMGCL	0.00250927	0.853779851	0.896420626	0.04264077	TssA
KCNQ1	0.01608712	0.305409504	0.252345675	-0.0530638	TssAFlnk	NLRP7	0.04142779	0.74225002	0.784692326	0.04244231	Quies
DCUN1D1	0.00337277	0.343221868	0.290481687	-0.0527402	TssA	GYS1	0.0198018	0.026711751	0.068418035	0.04170628	TssA
SLC7A7	0.02832055	0.690309878	0.637837042	-0.0524728	TxWk	GP2	0.03344997	0.776629295	0.817721131	0.04109184	Quies
HIGD1B	0.01818552	0.605133543	0.552813687	-0.0523199	TxWk	RMND5B	0.04641332	0.471877493	0.511670905	0.03979341	TssAFlnk
LBP	0.04086789	0.770208099	0.718145059	-0.052063	ReprPC	C9orf64	0.01785302	0.099988279	0.139696349	0.03970807	TssAFlnk
GALNT1	0.04346994	0.710678665	0.65961273	-0.0510659	Enh	SLC3A1	0.00176583	0.769025352	0.808057052	0.0390317	TxWk
BECN1	0.00298449	0.14614909	0.095647577	-0.0505015	TssA	LRTOMT	0.02260737	0.564218807	0.602164258	0.03794545	TssAFlnk
SMAD9	0.0051881	0.90175735	0.852180107	-0.0495772	Tx	ZNF45	0.03127447	0.787693737	0.825397879	0.03770414	Tx
SCG2	0.00064486	0.168819108	0.119323823	-0.0494953	Enh	PRAMEF1	0.01531912	0.706651253	0.742845395	0.03619414	Quies
MLC1	0.03227513	0.406694457	0.357306299	-0.0493882	TssAFlnk	HIVEP3	0.02562103	0.078483213	0.114035763	0.03555255	TssAFlnk
GOLGA9P	0.04602977	0.800967558	0.754177343	-0.0467902	Quies	PLA2G2D	0.02846063	0.832299523	0.867511682	0.03521216	ReprPC

SEPT1	0.02487987	0.765500146	0.718814362	-0.0466858	Quies	VAV1	0.03306356	0.309988851	0.344152147	0.0341633	ReprPCWk
ATP2C1	0.03747537	0.260341018	0.214084713	-0.0462563	TssA	C20orf186	0.03395926	0.688218533	0.721833861	0.03361533	ReprPCWk
H6PD	0.03927231	0.382372132	0.336303129	-0.046069	TssAFlnk	MACROD2	0.03868366	0.046309306	0.079640708	0.0333314	TssA
OCM2	0.04225779	0.73008521	0.685064662	-0.0450205	ReprPCWk	ATAD2	0.01906732	0.047254264	0.077391554	0.03013729	TssA
LTA	0.04154666	0.687621462	0.643460132	-0.0441613	ReprPCWk	KRTAP19-6	0.04791749	0.851254059	0.876441361	0.0251873	Quies
PPP2R4	0.01992989	0.473163979	0.430719258	-0.0424447	TssAFlnk	SMPDL3A	0.01099343	0.116184657	0.140065683	0.02388103	TssA
NCRNA00175	0.02392877	0.867539252	0.826420213	-0.041119	Quies	ZBTB8A	0.03871428	0.100757513	0.124133948	0.02337644	BivFlnk
SCN2A	0.0289227	0.282964737	0.243465874	-0.0394989	TssA	CCDC57	0.0220344	0.038554517	0.061715292	0.02316078	TssA
ARF5	0.00718366	0.484080213	0.44598496	-0.0380953	TssAFlnk	MMP8	0.02569413	0.783368309	0.806083587	0.02271528	ReprPCWk
GPR26	0.0310081	0.274979413	0.236933338	-0.0380461	ReprPC	PBK	0.03973871	0.035818919	0.057644218	0.0218253	TssAFlnk
PRRC1	0.04270081	0.180375278	0.142409366	-0.0379659	TssAFlnk	AADAC	0.02359167	0.880587594	0.901848197	0.0212606	Quies
CEACAM6	0.01669855	0.333204518	0.295602683	-0.0376018	ReprPCWk	CHRNA1	0.01807859	0.906184679	0.926547632	0.02036295	Quies
CNGB3	0.01525879	0.861039103	0.823648064	-0.037391	Quies	ARL11	0.03455042	0.870530924	0.88893985	0.01840893	Quies
CGB2	0.03990286	0.632652849	0.595263281	-0.0373896	Quies	C1orf183	0.03888011	0.077542569	0.093474042	0.01593147	TssAFlnk
CRBN	0.01182991	0.188113697	0.150726969	-0.0373867	TssAFlnk	AMY2B	0.04362334	0.908913606	0.924499085	0.01558548	Tx
THOP1	0.01158132	0.122685132	0.085362755	-0.0373224	TssAFlnk	WT1	0.04112907	0.050797118	0.065877667	0.01508055	ReprPC
ALPPL2	0.04040121	0.809976358	0.772784789	-0.0371916	ReprPCWk	MORN2	0.04058054	0.046936463	0.061726176	0.01478971	TssA
LEPR	0.01542529	0.166542865	0.129507388	-0.0370355	TssA	STK17B	0.02256286	0.02702971	0.041646987	0.01461728	TssA
TMEM92	0.04792627	0.196370935	0.160660077	-0.0357109	Enh	CPT1B	0.01651107	0.039439326	0.05306318	0.01362385	TssAFlnk
ABHD12B	0.00904213	0.823288755	0.787819225	-0.0354695	ReprPC	LOC388428	0.00811788	0.037823522	0.051111122	0.0132876	ReprPC
ACP6	0.04053718	0.416501475	0.383081335	-0.0334201	TxWk	MSX2	0.01282013	0.030345018	0.04228093	0.01193591	TssBiv
HLA-DRA	0.00857193	0.792671181	0.760332008	-0.0323392	ReprPCWk	ZBED5	0.0491847	0.045391981	0.057188533	0.01179655	TssA
SP6	0.02831129	0.624097728	0.59196655	-0.0321312	ReprPCWk	GDNF	0.04760486	0.042701431	0.054422101	0.01172067	TssAFlnk
CCDC82	0.03612089	0.094934119	0.062938062	-0.0319961	TssA	KRCC1	0.04203367	0.047540696	0.058594616	0.01105392	TssA
SIT1	0.04505777	0.772682389	0.741102364	-0.03158	TxWk	CHID1	0.00476953	0.031571075	0.042177567	0.01060649	TssAFlnk
TNNC2	0.03492048	0.819495715	0.788427384	-0.0310683	TxWk	GNB2L1	0.01378364	0.050702105	0.060596868	0.00989476	TssA
NANOS1	0.0371908	0.255867537	0.22535853	-0.030509	TssAFlnk	BBS10	0.04036868	0.026193923	0.035873037	0.00967911	TssA
CLEC2D	0.01369671	0.856343562	0.826412137	-0.0299314	TxWk	DCST1	0.03462806	0.945808182	0.955299518	0.00949134	ReprPCWk
PFKM	0.02850575	0.817469372	0.788433882	-0.0290355	TxWk	EIF4A3	0.0203592	0.038543476	0.047914477	0.009371	TssA
TFEC	0.02777643	0.157004403	0.129014455	-0.0279899	Enh	GCOM1	0.04540071	0.035413238	0.044632082	0.00921884	TssA
KCNN4	0.01630544	0.11842198	0.091238725	-0.0271833	TssAFlnk	SPOCK1	0.02696536	0.036294887	0.04538894	0.00909405	TssA
CTSO	0.00530965	0.086719641	0.059764406	-0.0269552	TssA	NFKB1	0.01184187	0.050847328	0.059911212	0.00906388	TssA
ZNF114	0.00447904	0.081185672	0.054771786	-0.0264139	TssA	UBAP2	0.04202495	0.037762288	0.045627223	0.00786494	TssA

KIAA1191	0.04444128	0.108579344	0.082232094	-0.0263473	TssAFInk	RPL18A	0.04068076	0.048714733	0.056577929	0.0078632	TssA
DUSP12	0.00666076	0.120625031	0.094886878	-0.0257382	TssAFInk	FAT1	0.01819613	0.035798988	0.043056425	0.00725744	TssA
TNFSF13B	0.02223739	0.117144795	0.091482651	-0.0256621	TssAFInk	TNPO1	0.00013379	0.027692093	0.034877472	0.00718538	TssAFInk
CDKAL1	0.02118422	0.11949895	0.093997714	-0.0255012	TssA	NMD3	0.01645587	0.032498112	0.039519469	0.00702136	TssA
NUP214	0.01357438	0.156217639	0.131127305	-0.0250903	TssAFInk	ATP5F1	0.03123527	0.574925735	0.581865353	0.00693962	TssAFInk
ZNF12	0.00466064	0.118223276	0.093641135	-0.0245821	TssAFInk	MIPEP	0.04127479	0.051499565	0.058434877	0.00693531	TssA
RRP15	0.04037583	0.117367783	0.092850757	-0.024517	TssA	KCNIP4	0.03050876	0.063838153	0.070149367	0.00631121	Quies
PKP4	0.0185401	0.276214491	0.252446312	-0.0237682	TssA	IHH	0.03610379	0.033806128	0.040012391	0.00620626	TssBiv
MCCC2	0.02628432	0.129649666	0.105944011	-0.0237057	TssAFInk	SEMA3C	0.0472525	0.035009309	0.0409549	0.00594559	TssA
ANKRA2	0.01826785	0.161939643	0.138318172	-0.0236215	TssA	TRABD	0.01443755	0.031177957	0.037110165	0.00593221	TssA
SP100	0.01823025	0.12104041	0.097442751	-0.0235977	TssA	PSD2	0.00576328	0.02647897	0.032331257	0.00585229	BivFInk
DEFB1	0.0074216	0.900378325	0.87698702	-0.0233913	ReprPC	IFT81	0.04147953	0.04379508	0.049370253	0.00557517	TssAFInk
GSTP1	0.00741042	0.127578081	0.104214551	-0.0233635	TssAFInk	LGALS3	0.04370476	0.015914557	0.021489236	0.00557468	TssA
UBB	0.01826876	0.118438046	0.095113024	-0.023325	TssA	INPP1	0.00599696	0.030820253	0.036337689	0.00551744	TssAFInk
SACM1L	0.0264931	0.141304522	0.118168238	-0.0231363	TssA	CDKN2D	0.03546617	0.046358779	0.051817342	0.00545856	TssAFInk
DCDC1	0.00972762	0.113096546	0.090545831	-0.0225507	TssA	DFNB31	0.01831463	0.024928539	0.030310255	0.00538172	TssA
LOC388428	0.04900847	0.584248246	0.561823596	-0.0224246	ReprPC	RAB13	0.03212502	0.027535108	0.032739686	0.00520458	TssAFInk
UFD1L	0.00177682	0.092737764	0.070484402	-0.0222534	TssA	C16orf70	0.01634673	0.02104584	0.026249662	0.00520382	TssAFInk
PIGB	0.02703708	0.071308384	0.049273113	-0.0220353	TssA	E2F7	0.0433037	0.02744869	0.032555147	0.00510646	TssA
C9	0.03404764	0.90105839	0.879612419	-0.021446	Quies	EMX1	0.04860867	0.028324145	0.033043429	0.00471928	ReprPC
TUBA1A	0.03296692	0.218534686	0.197223517	-0.0213112	TssA	ADCY4	0.04823056	0.025038285	0.029424503	0.00438622	TssAFInk
ACRBP	0.00271134	0.908022767	0.886885013	-0.0211378	Tx	NFX1	0.01791818	0.024650232	0.02891902	0.00426879	TssA
C2orf44	0.02025651	0.088379364	0.067414327	-0.020965	TssA	GSK3A	0.03454229	0.019259441	0.023381746	0.00412231	TssA
ESPL1	0.01447895	0.095881361	0.074970591	-0.0209108	TssA	ACE	0.03551541	0.019937153	0.023554564	0.00361741	TssA
SPTBN2	0.03665397	0.899383278	0.878921867	-0.0204614	ReprPCWk	DNAJA3	0.03547632	0.024008724	0.027615616	0.00360689	TssA
WHSC2	0.0266749	0.135753881	0.115416242	-0.0203376	TssAFInk	TECR	0.00995436	0.020387784	0.023458414	0.00307063	TssA
TWSG1	0.01477153	0.077472661	0.057729954	-0.0197427	TssAFInk	GSTM2	0.01634592	0.018959747	0.021528335	0.00256859	TssA
ACSBG2	0.0373333	0.87543063	0.855785676	-0.019645	Quies						
TCEB1	0.04825173	0.097651759	0.078450727	-0.019201	TssA						
MOCS1	0.03768025	0.90920213	0.890958014	-0.0182441	TxWk						
NOL12	0.0042019	0.082621306	0.064493009	-0.0181283	TssAFInk						
RHBDD3	0.006972	0.092489242	0.075109723	-0.0173795	TssAFInk						
C16orf70	0.03161925	0.053987801	0.036630261	-0.0173575	TssA						

C6orf108	0.00353825	0.073582125	0.056282354	-0.0172998	TssAFlnk
TAF5	0.01233357	0.06378397	0.046606021	-0.0171779	TssA
BMI1	0.03977099	0.059560123	0.042499812	-0.0170603	TssA
HOXA9	0.02893433	0.075681989	0.058773833	-0.0169082	TssA
C1orf61	0.04102823	0.095798732	0.078914685	-0.016884	ReprPC
FDFT1	0.04751252	0.054325044	0.037461854	-0.0168632	TssA
SCGB2A2	0.03031629	0.840887446	0.824663857	-0.0162236	ReprPCWk
IDH3A	0.00605313	0.07646527	0.060362162	-0.0161031	TssA
SPAG8	0.01459712	0.059483616	0.043595364	-0.0158883	TssA
TRIM52	0.03793486	0.074715717	0.058972862	-0.0157429	TssA
CTTNBP2NL	0.02102139	0.063446364	0.047770009	-0.0156764	TssAFlnk
FEN1	0.0132314	0.060697192	0.04570941	-0.0149878	TssA
ARAP1	0.03119021	0.068697585	0.053845278	-0.0148523	TssAFlnk
P2RY2	0.02193957	0.061330251	0.047030434	-0.0142998	TssAFlnk
LYST	0.03838011	0.064404389	0.050144081	-0.0142603	TssAFlnk
CREG1	0.01089236	0.070886466	0.056716703	-0.0141698	TssAFlnk
TRNAU1AP	0.03449519	0.084005947	0.069869466	-0.0141365	TssA
TCEB1P	0.01030404	0.886625633	0.872700806	-0.0139248	TxWk
CENPO	0.02035497	0.069786227	0.055879655	-0.0139066	TssAFlnk
MRPS14	0.00896861	0.087784565	0.073952843	-0.0138317	TssA
ZNF684	0.01498347	0.067587301	0.053842915	-0.0137444	TssA
SIRT5	0.02632483	0.074327427	0.060759822	-0.0135676	TssA
GRM2	0.02441085	0.804866927	0.791359337	-0.0135076	ReprPCWk
CIRH1A	0.03804824	0.045322307	0.031825228	-0.0134971	TssA
EIF3K	0.0251968	0.075008268	0.061525977	-0.0134823	TssA
C17orf80	0.01993751	0.071518723	0.058163208	-0.0133555	TssA
ZNF426	0.04555207	0.054427399	0.041114844	-0.0133126	TssA
TNKS	0.01138186	0.085266021	0.072143523	-0.0131225	TssAFlnk
IGFBP3	0.00533531	0.067707863	0.054606815	-0.013101	TssAFlnk
NAT8L	0.04089995	0.090589777	0.077927318	-0.0126625	ReprPCWk
FAM73B	0.03541064	0.060473307	0.047865617	-0.0126077	TssA
WDR17	0.0177667	0.052012355	0.039627899	-0.0123845	BivFlnk
PTER	0.02102671	0.057654329	0.045273243	-0.0123811	TssA

MORN4	0.02137065	0.115248052	0.10287719	-0.0123709	TssA
PIAS1	0.00355468	0.048704108	0.036451978	-0.0122521	TssA
CCDC12	0.00514437	0.080636414	0.06845807	-0.0121783	TssA
TOMM20L	0.02645209	0.109360371	0.097184846	-0.0121755	TssAFlnk
CDK12	0.04639584	0.068108284	0.055955295	-0.012153	TssA
AVEN	0.01015559	0.060997665	0.048912241	-0.0120854	TssA
IGFBP3	0.01315997	0.114753625	0.102682648	-0.012071	TssAFlnk
AGPAT1	0.01362337	0.046738134	0.034692025	-0.0120461	TssA
USE1	0.01127456	0.041426146	0.029404013	-0.0120221	TssA
ITSN2	0.0007257	0.052831452	0.040918851	-0.0119126	TssA
C11orf24	0.01139479	0.076842742	0.065003778	-0.011839	TssAFlnk
MRPL12	0.00120779	0.044008316	0.032608585	-0.0113997	TssA
BET1	0.03794652	0.07144943	0.060133976	-0.0113155	TssA
MTFR1	0.00670409	0.050829184	0.039594549	-0.0112346	TssAFlnk
CCNO	0.01057098	0.053418187	0.042223105	-0.0111951	TssAFlnk
RAMP2	0.02047989	0.069592117	0.058401215	-0.0111909	TssBiv
RGS4	0.02285144	0.058440985	0.047359888	-0.0110811	TssA
UGDH	0.01736461	0.053011505	0.042233866	-0.0107776	TssA
SIRPA	0.04905657	0.05439883	0.04384717	-0.0105517	TssAFlnk
SMEK1	0.02376752	0.050496735	0.039990431	-0.0105063	TssAFlnk
PKIG	0.02931239	0.053280498	0.042794386	-0.0104861	TssA
ARHGAP11A	0.01443503	0.044333835	0.033855903	-0.0104779	TssA
PCYOX1L	0.01033408	0.061857186	0.051443557	-0.0104136	TssAFlnk
FKBP7	0.0358445	0.059603281	0.049262723	-0.0103406	TssA
ITPR2	0.00052306	0.043768212	0.033483095	-0.0102851	TssA
RASGRP2	0.02227512	0.052620769	0.042389651	-0.0102311	BivFlnk
ICA1	0.03534593	0.076066103	0.065863172	-0.0102029	TssBiv
C19orf22	0.00239819	0.037354364	0.027234903	-0.0101195	TssA
EXOC7	0.03377622	0.051401987	0.041369025	-0.010033	TssAFlnk
PROS1	0.0009823	0.041866449	0.031905781	-0.0099607	TssAFlnk
KDELC1	0.02208017	0.034077508	0.024234884	-0.0098426	TssA
C6orf208	0.00479972	0.06040128	0.05074725	-0.009654	TssAFlnk
ATXN7	0.04937938	0.047494644	0.037853918	-0.0096407	TssAFlnk

AP3D1	0.00524164	0.048159624	0.038528961	-0.0096307	TssA
C17orf79	0.04502456	0.043775647	0.034335881	-0.0094398	TssAFlnk
THAP7	0.00088371	0.036083783	0.026646513	-0.0094373	TssA
DUSP11	0.0404954	0.056499579	0.047084587	-0.009415	TssA
ARMC4	0.01009932	0.056141836	0.046740352	-0.0094015	TssA
ARHGEF10L	0.00126943	0.041833181	0.03245695	-0.0093762	TssA
STK17A	0.00374104	0.042109881	0.032798714	-0.0093112	TssA
STRBP	0.00100071	0.033882343	0.024694862	-0.0091875	TssBiv
C17orf71	0.0161824	0.045126476	0.035970345	-0.0091561	TssA
KRIT1	0.00693537	0.046675824	0.037755767	-0.0089201	TssA
LPPR2	0.00109955	0.031538833	0.02263574	-0.0089031	TssA
SGK3	0.04364248	0.054258537	0.045389527	-0.008869	TssAFlnk
SMARCAL1	0.01388802	0.948274424	0.939438161	-0.0088363	TxWk
H3F3B	0.01309699	0.034622164	0.025840709	-0.0087815	TssA
VAX2	0.0148674	0.054230668	0.045457854	-0.0087728	TssBiv
NPAS1	0.03995326	0.067080752	0.058338268	-0.0087425	TssA
SOX2	0.01779516	0.04084208	0.032116939	-0.0087251	TssBiv
VWC2	0.01692226	0.069296446	0.060582251	-0.0087142	ReprPC
NFKB2	0.00312917	0.056645442	0.047938927	-0.0087065	TssA
GMNN	0.04735248	0.058779983	0.050103873	-0.0086761	TssAFlnk
RPS3	0.01956712	0.03925675	0.030604353	-0.0086524	TssA
LASS1	0.03598191	0.066959587	0.058329739	-0.0086298	TssA
GTF2B	0.01908092	0.045865191	0.037292047	-0.0085731	TssA
TUSC4	0.02625848	0.058748009	0.050217253	-0.0085308	TssA
UBQLN1	0.01920543	0.03219752	0.023676935	-0.0085206	TssA
IL2RB	0.03587898	0.947858472	0.93933824	-0.0085202	ReprPCWk
GALNT10	0.04841726	0.05409313	0.045603731	-0.0084894	TssA
STK3	0.00553781	0.060450066	0.052026068	-0.008424	TssA
USP32	0.02363012	0.063247487	0.054846043	-0.0084014	TssA
TRAF3	0.02601893	0.045850719	0.03754884	-0.0083019	TssA
SERTAD1	0.04282193	0.035015134	0.026726167	-0.008289	TssA
BCCIP	0.04669591	0.040458306	0.032172298	-0.008286	TssA
FCF1	0.01193274	0.055425143	0.047139287	-0.0082859	TssA

DHRS7	0.00800592	0.041152685	0.032874208	-0.0082785	TssA
PLEKHA1	0.00061521	0.047796199	0.03952023	-0.008276	TssAFlnk
IL6ST	0.04540702	0.047725303	0.039455359	-0.0082699	TssA
KLF16	0.00227269	0.051629374	0.043367391	-0.008262	TssA
MLLT1	0.03897436	0.052100132	0.043838649	-0.0082615	TssA
ARL6IP1	0.04564164	0.046699176	0.038470366	-0.0082288	TssAFlnk
KRAS	0.00988549	0.036345936	0.028227001	-0.0081189	TssA
DEDD2	0.01413059	0.045526981	0.03743779	-0.0080892	TssA
HOXB7	0.01070765	0.045636455	0.037630793	-0.0080057	TssAFlnk
USP49	0.00582399	0.054121718	0.046120445	-0.0080013	TssA
TERF2	0.01469355	0.034359892	0.026364124	-0.0079958	TssA
VPS13A	0.00659205	0.031647725	0.023706753	-0.007941	TssA
KCNT2	0.01553165	0.049057339	0.041117341	-0.00794	TssA
GCAT	0.03620264	0.062470726	0.05453672	-0.007934	TssAFlnk
NUP35	0.0254194	0.060064311	0.052214267	-0.00785	TssA
AGL	0.02027	0.050457438	0.042611496	-0.0078459	TssA
SMAD7	0.0005026	0.029653223	0.021852678	-0.0078005	TssA
HIST1H2AH	0.00808432	0.046055959	0.038273324	-0.0077826	TssA
ITSN1	0.0238299	0.0441831	0.036444203	-0.0077389	TssA
ALKBH6	0.01782156	0.046559816	0.038832702	-0.0077271	TssA
AP1AR	0.00326201	0.036492837	0.028769461	-0.0077234	TssA
CCBL1	0.03751351	0.039116261	0.031449002	-0.0076673	TssA
CDK5RAP2	0.02986907	0.035277045	0.027678795	-0.0075982	TssAFlnk
CUL3	0.04388957	0.0656926	0.058124414	-0.0075682	TssAFlnk
ZNF643	0.04162479	0.046473679	0.038915015	-0.0075587	TssA
INTS4	0.00407534	0.040608153	0.033081192	-0.007527	TssA
PAK4	0.04062459	0.042058284	0.034597568	-0.0074607	TssA
CDC42EP4	0.02315251	0.030428929	0.02297559	-0.0074533	TssA
SMU1	0.04728724	0.048591359	0.041146949	-0.0074444	TssA
U2AF1	0.01377259	0.039058326	0.031662282	-0.007396	TssAFlnk
CHPT1	0.03929987	0.070358187	0.062976329	-0.0073819	TssAFlnk
TFG	0.01600953	0.046099631	0.038740256	-0.0073594	TssA
KIF17	0.00963256	0.023078774	0.015760701	-0.0073181	TssA

SLC31A2	0.00393025	0.036366321	0.029096062	-0.0072703	TssA
PCDH1	0.02513833	0.046705451	0.039438951	-0.0072665	TssA
DDT	0.03811795	0.035823731	0.028576199	-0.0072475	Quies
TTK	0.04646597	0.04869781	0.041591245	-0.0071066	TssA
KDM3A	0.02266132	0.048086996	0.040982033	-0.007105	TssA
LGI3	0.04265164	0.049807164	0.042715149	-0.007092	BivFlnk
FLRT2	0.00199561	0.026195755	0.019122182	-0.0070736	TssA
DNAJB4	0.03251859	0.056508587	0.049469755	-0.0070388	TssA
ATP2A3	0.00776928	0.044936381	0.037955749	-0.0069806	BivFlnk
PTPLA	0.04452423	0.066879277	0.059931982	-0.0069473	TssAFlnk
NDUFC2	0.01795521	0.050447502	0.04350535	-0.0069422	TssA
PER1	0.02104779	0.033892004	0.027031512	-0.0068605	TssA
MYH10	0.03778243	0.041882373	0.035028865	-0.0068535	TssA
C15orf57	0.03922952	0.054039371	0.047264384	-0.006775	TssA
C4orf22	0.04745935	0.033052354	0.026282654	-0.0067697	TssA
FOXA3	0.00848282	0.03672584	0.029979165	-0.0067467	TssBiv
WNT2B	0.02359799	0.031868981	0.025173465	-0.0066955	TssAFlnk
DCBLD2	0.0269049	0.03629647	0.029604015	-0.0066925	TssA
EPHB1	0.0148784	0.029825086	0.023135839	-0.0066892	TssAFlnk
LETM2	0.00031652	0.040410532	0.033733035	-0.0066775	TssA
PRR16	0.0370732	0.038023884	0.031347138	-0.0066767	TssA
PFKP	0.02966705	0.044756992	0.038090524	-0.0066665	TssA
GLUL	0.03235519	0.033324048	0.026704556	-0.0066195	TssA
LSS	0.02605935	0.031966578	0.025366591	-0.0066	TssA
BMP2K	0.03128836	0.043393063	0.036796414	-0.0065966	TssA
NDUFB8	0.01228649	0.057234369	0.050643589	-0.0065908	TssA
MLH3	0.00328819	0.047078832	0.040493357	-0.0065855	TssAFlnk
ADAP2	0.03424522	0.048030029	0.04144584	-0.0065842	TssBiv
RAB8B	0.00060179	0.031104496	0.024539027	-0.0065655	TssA
MRC2	0.00273905	0.042787124	0.036234947	-0.0065522	TssA
ARHGEF17	0.02277319	0.03356517	0.027015347	-0.0065498	TssA
FN1	0.03448488	0.039985565	0.033477844	-0.0065077	TxFlnk
CREB3	0.04158884	0.031667577	0.025162	-0.0065056	TssA

RNF19B	0.02890762	0.064596163	0.058092587	-0.0065036	TssA
RETSAT	0.01066965	0.037967675	0.031476318	-0.0064914	TssAFlnk
DNAJC18	0.02152515	0.036644171	0.030191778	-0.0064524	TssA
RNGTT	0.04531341	0.044450894	0.038018697	-0.0064322	TssA
ZC3H15	0.04546441	0.038939013	0.03251481	-0.0064242	TssA
SMOC2	0.03317958	0.048631675	0.042218451	-0.0064132	BivFlnk
PEX5	0.01092912	0.03602895	0.029622498	-0.0064065	TssA
BOP1	0.03290605	0.042911297	0.036521153	-0.0063901	TssA
LHFP	0.00073665	0.032626304	0.026259935	-0.0063664	TssA
EEF2	0.02866073	0.046690131	0.040331737	-0.0063584	TssAFlnk
STK36	0.03508778	0.046235218	0.039892968	-0.0063422	TssA
FAM70B	0.00896003	0.032153234	0.025831149	-0.0063221	TssAFlnk
SFRS14	0.03721516	0.043964896	0.03764365	-0.0063212	TssAFlnk
MCM7	0.04014743	0.045521396	0.039217684	-0.0063037	TssA
C10orf2	0.03806278	0.036915608	0.03061285	-0.0063028	TssA
TIGD3	0.0427174	0.030368287	0.024070534	-0.0062978	TssAFlnk
PTPN23	0.00725224	0.034041976	0.027762767	-0.0062792	TssA
NINJ1	0.0472017	0.033151483	0.026929698	-0.0062218	TssAFlnk
UTP3	0.00939888	0.038936324	0.032714845	-0.0062215	TssA
NUP54	0.01480584	0.031004631	0.024836109	-0.0061685	TssA
REXO2	0.01546754	0.04342376	0.037297292	-0.0061265	TssAFlnk
MATR3	0.01068208	0.034828753	0.028703622	-0.0061251	TssAFlnk
LOXL2	0.02245811	0.031658309	0.025549177	-0.0061091	TssA
TUBA1B	0.00358028	0.036268205	0.030177061	-0.0060911	TssAFlnk
CWF19L1	0.01246995	0.047344703	0.041277455	-0.0060672	TssA
TMEM199	0.04972813	0.048803432	0.042744418	-0.006059	TssA
SF3A3	0.02993303	0.02993803	0.023890539	-0.0060475	TssA
RPS27A	0.00100538	0.035633462	0.029611451	-0.006022	TssA
WDSUB1	0.02107152	0.031354156	0.025349	-0.0060052	TssA
BBS4	0.0182609	0.053419114	0.047435334	-0.0059838	TssA
CNDP2	0.03495629	0.062854994	0.056897492	-0.0059575	TssA
DPP3	0.00528205	0.025895318	0.019951473	-0.0059438	TssA
ZNF660	0.01648934	0.031827414	0.025885318	-0.0059421	TssAFlnk

ULK1	0.00326767	0.026577397	0.020641378	-0.005936	TssA
PSMG1	0.01365757	0.029686637	0.023756551	-0.0059301	TssA
NUDT22	0.01549225	0.035585074	0.029682654	-0.0059024	TssA
GAS6	0.01685254	0.032213199	0.026317906	-0.0058953	TssA
ST3GAL5	0.04150829	0.051416702	0.045528019	-0.0058887	TssA
NUDCD3	0.0150433	0.039404708	0.033517247	-0.0058875	TssA
CYBASC3	0.02461417	0.045603319	0.039730212	-0.0058731	TssA
AKR1B1	0.04549819	0.029444518	0.023581247	-0.0058633	TssA
MEN1	0.02410109	0.043853914	0.038022986	-0.0058309	TssA
ARL8A	0.02869655	0.043138836	0.037325448	-0.0058134	TssAFlnk
ZNF276	0.00909222	0.035009906	0.029197936	-0.005812	TssA
AHCY	0.0363606	0.031200935	0.025393757	-0.0058072	TssA
FBXL3	0.03831974	0.027499836	0.021722499	-0.0057773	TssA
STAM2	0.03136427	0.036307626	0.030534372	-0.0057733	TssA
FBXW7	0.02734912	0.044270636	0.03852394	-0.0057467	TssA
TWSG1	0.00761005	0.022498632	0.016775025	-0.0057236	TssA
ETHE1	0.03137927	0.033797762	0.028114872	-0.0056829	TssA
STOM	0.00102201	0.029165688	0.023483217	-0.0056825	TssA
BAT5	0.0291427	0.040582538	0.03490279	-0.0056797	TssA
MCL1	0.01655259	0.040500803	0.034852362	-0.0056484	TssA
STK10	0.04834753	0.033978691	0.028351045	-0.0056276	TssA
FAR1	0.02936404	0.043344516	0.037728827	-0.0056157	TssA
RRBP1	0.03399537	0.028579976	0.02298511	-0.0055949	TssA
PLK2	0.04484715	0.034875861	0.029289226	-0.0055866	TssA
ERBB3	0.02285439	0.047303575	0.041758356	-0.0055452	TssAFlnk
RAB11FIP5	0.00332487	0.040105651	0.034606307	-0.0054993	TssAFlnk
NAALAD2	0.01189535	0.044212908	0.038720793	-0.0054921	TssA
TP53INP2	0.01261778	0.024645596	0.019155823	-0.0054898	TssA
PMS2L3	0.01074602	0.03455385	0.029118371	-0.0054355	TssA
ADAMTS1	0.04904234	0.050295089	0.044883048	-0.005412	TssA
GLYR1	0.04709291	0.029560909	0.024149022	-0.0054119	TssA
CCAR1	0.00241788	0.038014532	0.03260791	-0.0054066	TssA
CANT1	0.04274823	0.034954193	0.029557009	-0.0053972	TssAFlnk

GABRA2	0.03699709	0.03111229	0.025749594	-0.0053627	ReprPC
TTC12	0.01301609	0.023072572	0.017715076	-0.0053575	TssA
ZBTB7A	0.02050866	0.042146759	0.036803402	-0.0053434	TssA
SGTB	0.00077659	0.03942572	0.034086143	-0.0053396	TssA
LITAF	0.04648308	0.051953222	0.046675193	-0.005278	TssA
C7orf25	0.0269682	0.037988643	0.032726966	-0.0052617	TssA
SLCO4A1	0.01757595	0.038084745	0.032833034	-0.0052517	ReprPC
TMF1	0.00671608	0.027798594	0.022568218	-0.0052304	TssA
MAP4K5	0.02883626	0.029934501	0.024704909	-0.0052296	TssAFlnk
EMP2	0.00624884	0.027349989	0.022160558	-0.0051894	TssA
ZBTB5	0.03392047	0.048405136	0.0432341	-0.005171	TssA
CDS1	0.00811835	0.032405454	0.027299728	-0.0051057	BivFlnk
FPGS	0.00229857	0.029778548	0.024699525	-0.005079	TssAFlnk
SERF2	0.00814691	0.023377113	0.018315587	-0.0050615	TssA
VPS45	0.01640619	0.035861665	0.030800555	-0.0050611	TssA
TARBP1	0.0435149	0.025222101	0.02016585	-0.0050563	TssA
MC1R	0.02320604	0.033590337	0.028567752	-0.0050226	TssAFlnk
NEIL3	0.01888028	0.031200387	0.026225273	-0.0049751	TssA
EPST11	0.00701157	0.029503391	0.024547546	-0.0049558	TssAFlnk
RDX	0.02380704	0.042601302	0.037647363	-0.0049539	TssA
SPATA13	0.03719954	0.031040205	0.026103613	-0.0049366	TssA
RFC1	0.04848803	0.047889548	0.04295935	-0.0049302	TssAFlnk
GPR89B	0.02137601	0.03223586	0.027325306	-0.0049106	TssA
FECH	0.00973006	0.03206643	0.027175104	-0.0048913	TssA
CDC26	0.03723455	0.042397754	0.037509281	-0.0048885	TssA
CUX1	0.01414414	0.039064938	0.034180442	-0.0048845	TssAFlnk
MFN1	0.01668114	0.029157108	0.024285306	-0.0048718	TssA
ZNF671	0.01395794	0.044698792	0.039855141	-0.0048437	TssA
TRNT1	0.03320163	0.033112851	0.028289192	-0.0048237	TssA
CBL	0.00283196	0.028674703	0.023867995	-0.0048067	TssA
FAM179B	0.03438575	0.028397988	0.023592436	-0.0048056	TssA
NTN4	0.03333845	0.028466065	0.023679604	-0.0047865	TssA
LASP1	0.03594794	0.027527147	0.02274656	-0.0047806	TssA

MAD2L2	0.00923308	0.029745355	0.024979685	-0.0047657	TssAFlnk
PPP1R14C	0.01121106	0.031878957	0.027152898	-0.0047261	TssA
H6PD	0.04374972	0.026859752	0.022141668	-0.0047181	TssAFlnk
DSTN	0.0018111	0.029776866	0.025107676	-0.0046692	TssA
PPME1	0.03481161	0.035156701	0.030489916	-0.0046668	TssA
MAN1B1	0.00443746	0.021132082	0.016495719	-0.0046364	TssA
CENPM	0.02375524	0.02888732	0.024251195	-0.0046361	TssA
NFYB	0.03665324	0.028489059	0.023876936	-0.0046121	TssA
RAB20	0.01294929	0.043589041	0.038988874	-0.0046002	TssA
CAPNS1	0.03470187	0.022756023	0.018172161	-0.0045839	TssA
USP5	0.00899156	0.037896448	0.033347318	-0.0045491	TssA
LEO1	0.01888537	0.027399025	0.022896731	-0.0045023	TssA
CCNYL1	0.02260043	0.030267574	0.025776493	-0.0044911	TssA
NQO2	0.02546066	0.032966867	0.028515429	-0.0044514	TssAFlnk
ERCC2	0.04136944	0.048266662	0.043831433	-0.0044352	TssA
HINFP	0.00797935	0.02820367	0.023772577	-0.0044311	TssA
FOS	0.02099371	0.033525014	0.029113153	-0.0044119	TssA
RBM19	0.01434966	0.03110754	0.026715434	-0.0043921	TssA
C18orf54	0.00402347	0.024806613	0.020458184	-0.0043484	TssA
DCAF4	0.03007014	0.03642753	0.032080046	-0.0043475	TssA
TRAF7	0.0484326	0.040084122	0.035765608	-0.0043185	TssA
LRRC59	0.0405282	0.03056687	0.026260483	-0.0043064	TssA
PRRG4	0.04203942	0.033617409	0.029312082	-0.0043053	TssAFlnk
ENTPD6	0.03877374	0.022667136	0.018398361	-0.0042688	TssA
ZSCAN22	0.01559393	0.021025168	0.016781798	-0.0042434	TssA
SNAI1	0.02292081	0.030572682	0.026367648	-0.004205	TssA
TMEM159	0.01386308	0.035893077	0.031707856	-0.0041852	TssAFlnk
PTGR2	0.03003093	0.031356447	0.027215262	-0.0041412	TssA
TMEM38B	0.03764373	0.033724022	0.029586247	-0.0041378	TssA
NIPSNAP3B	0.0122543	0.027988287	0.023857908	-0.0041304	TssA
DIABLO	0.04397074	0.025067625	0.02094181	-0.0041258	TssA
AQP6	0.03628381	0.029606234	0.025485378	-0.0041209	TssAFlnk
USP13	0.00902235	0.025854934	0.02174893	-0.004106	TssA

SSSCA1	0.01068533	0.028406971	0.02432964	-0.0040773	TssA
SMPD1	0.0118565	0.021748686	0.017675199	-0.0040735	TssAFlnk
EPHB3	0.00916313	0.031185778	0.027112542	-0.0040732	TssAFlnk
BMPR1A	0.01521057	0.028084917	0.024048654	-0.0040363	TssA
POLE	0.04889595	0.026579854	0.022576022	-0.0040038	TssA
TSSK3	0.02752596	0.026057673	0.022072311	-0.0039854	TssAFlnk
CABC1	0.02954861	0.02316912	0.019225694	-0.0039434	TssA
RAC1	0.04915629	0.028953652	0.025042791	-0.0039109	TssA
GNPTAB	0.04334063	0.024811906	0.020907328	-0.0039046	TssA
BRI3	0.01304725	0.023208101	0.019316754	-0.0038913	TssA
SLC35E2	0.04553249	0.033369272	0.029522135	-0.0038471	TssA
CYP26A1	0.03764375	0.03380063	0.029971452	-0.0038292	BivFlnk
TMEM117	0.02586041	0.030684926	0.026930256	-0.0037547	TssA
CCNT1	0.02605111	0.030583614	0.026892184	-0.0036914	TssA
KDM5B	0.02741302	0.021445782	0.01775871	-0.0036871	TssA
ROCK1	0.04257202	0.019868681	0.016227997	-0.0036407	TssA
B3GAT1	0.03037106	0.021145565	0.017530296	-0.0036153	ReprPCWk
MEIS1	0.04891204	0.024884873	0.021277772	-0.0036071	TssA
ETF1	0.02014838	0.023614922	0.020019365	-0.0035956	TssA
NTNG1	0.018203	0.02852333	0.02493563	-0.0035877	BivFlnk
RHPN2	0.02311493	0.027222221	0.023648314	-0.0035739	TssBiv
ZNF14	0.04370669	0.025965324	0.022403379	-0.0035619	TssA
SNX5	0.03034468	0.027689118	0.024150051	-0.0035391	TssA
B3GALNT1	0.0315624	0.029384634	0.025865096	-0.0035195	TssA
NSUN4	0.02039014	0.022290656	0.01877373	-0.0035169	TssA
GNL1	0.04687876	0.020808035	0.017338077	-0.00347	TssA
NSUN5	0.03684782	0.03568951	0.03225072	-0.0034388	TssA
ZNF295	0.01351433	0.026961538	0.023528252	-0.0034333	TssA
HIC2	0.03786639	0.019588719	0.016157559	-0.0034312	Quies
PDIA2	0.04693515	0.02709105	0.023678939	-0.0034121	ReprPCWk
ASCC3	0.04767309	0.018934135	0.015539075	-0.0033951	TssA
ADARB1	0.03262539	0.027979275	0.024623745	-0.0033555	TssA
MED8	0.03505012	0.021291135	0.017974585	-0.0033165	TssA

TM9SF1	0.04082707	0.024421242	0.021175558	-0.0032457	TssA
PRPF38B	0.00551465	0.01854962	0.015305946	-0.0032437	TssA
CA11	0.04509736	0.026005145	0.022817215	-0.0031879	TssAFlnk
LRRG61	0.04574681	0.032986111	0.029806612	-0.0031795	TssAFlnk
CDKN1C	0.02679909	0.02542377	0.022245944	-0.0031778	TssA
STAM	0.0387211	0.0267589	0.023613007	-0.0031459	TssA
GSC	0.01332164	0.025147409	0.022025225	-0.0031222	ReprPC
CEBPA	0.02221256	0.019262368	0.016145881	-0.0031165	TssA
PGM2	0.04123314	0.026056363	0.023050605	-0.0030058	TssA
DSP	0.02682411	0.020630535	0.017625438	-0.0030051	TssA
DMRTA1	0.04076872	0.019750532	0.016782445	-0.0029681	TssA
PDIA6	0.03475949	0.02245816	0.019490628	-0.0029675	TssA
COPB2	0.04184806	0.027457997	0.024524746	-0.0029333	TssA
CENPJ	0.00981501	0.019545873	0.016694804	-0.0028511	TssA
SETD7	0.03375734	0.029944901	0.027105663	-0.0028392	TssA
ZBTB48	0.03920383	0.020995358	0.018179259	-0.0028161	TssA
POLR2J2	0.0492179	0.021502514	0.01872032	-0.0027822	TssA
TBL3	0.04156133	0.026796379	0.024044247	-0.0027521	TssA
ARRDC2	0.02379111	0.014626499	0.011918685	-0.0027078	TssA
ADAMTS9	0.04393183	0.030832121	0.028160834	-0.0026713	TssAFlnk
SLC2A13	0.02550401	0.024561559	0.021906098	-0.0026555	TssA
ABCC5	0.04430486	0.026141737	0.023559563	-0.0025822	TssA
C2orf42	0.03119265	0.02589365	0.023365256	-0.0025284	TssA
EPHB6	0.04465606	0.024686511	0.022177286	-0.0025092	TssAFlnk
TRPA1	0.04110428	0.031612448	0.029232611	-0.0023798	TssBiv
ACSF2	0.04273206	0.021248041	0.019002209	-0.0022458	TssA
B9D2	0.03150836	0.042199432	0.040291668	-0.0019078	TssAFlnk
CDK2AP1	0.04972714	0.024136821	0.02239486	-0.001742	TssA

DML: differentially methylated loci; mtDNA: mitochondrial DNA; TssA: active transcription start site; TssAFlnk: transcription at gene 5' and 3'; TxFlnk: strong transcription; TxWk: weak transcription; Enh: enhancer; TssBiv: bivalent/poised transcription start site; BivFlnk: bivalent enhancer; ReprPC: Repressed PolyComb; ReprPCWk: weak repressed PolyComb; Quies: quiescent/low; adj. p-value: adjusted p-values calculated by Bonferroni's method

S2 table. Differentially expressed genes between mtDNA haplogroups J and H sorted by decreased logFc

Increased expression in mtDNA haplogroup H in relation to J			Increased expression in mtDNA haplogroup J in relation to H		
GENE SYMBOL	adj. p-value	logFc	GENE SYMBOL	adj. p-value	logFc
FOSB	0.03998083	3.478529174	SCN5A	0.000907108	7.013483898
TAS2R31	0.030067242	3.433978661	ATP2C2	0.000839286	6.92543196
TBC1D3L	0.029154877	3.413960418	MROH2A	0.001270518	6.835315507
CTGF	0.022397751	3.302501323	TLX1	0.000839286	6.807543643
AC005324.8	0.035007673	3.146840916	TLL1	0.001116654	6.580521745
OSCAR	0.029386385	3.145865483	STAB2	0.011137621	6.541071584
SOD3	0.034634315	3.135166024	PTPRT	0.003078355	6.495487326
GPX3	0.048592903	2.964838113	EYA2	0.001098212	6.486761238
RSC1A1	0.032120977	2.938135424	SPTA1	0.000907108	6.436467797
CEBPD	0.045865205	2.886009883	MUC16	0.005056309	6.428173657
ZFP36	0.046181364	2.820222039	AQP12B	0.000839286	6.41596414
CST3	0.017748612	2.795276953	STXBP5L	0.000839286	6.365605044
VIM	0.03352273	2.71725799	FBN3	0.00131709	6.357744641
DUSP1	0.048530058	2.694311542	ADGRL3	0.001348285	6.21781099
KLF2	0.02792498	2.51153556	DNAH8	0.001804147	6.207393936
STC2	0.027323034	2.472495807	LRRC71	0.001098212	6.204126262
NAMPT	0.022275795	2.384588147	SLC22A8	0.001098212	6.203149651
ERRF1	0.045800126	2.384056558	VWA5B2	0.002020397	6.176655969
ZNF385B	0.006592803	2.315358783	EPS8L3	0.000907108	6.163148974
ZBTB16	0.013349591	2.313422528	SH3GL2	0.003022595	6.141789901
SOX9	0.02551613	2.294780119	OTOG	0.001712362	6.094021175
SERPING1	0.04315234	2.284860228	PRSS36	0.001109021	6.012235637
CSPG4	0.037835852	2.284441883	GPR158	0.000907108	5.990188936
SRRM2	0.028088316	2.220781427	PTPRO	0.001257521	5.990133673
LENG8	0.028081249	2.21736219	KCNQ1	0.000839286	5.987750573
KLF4	0.024681415	2.201584151	MUC3A	0.003268599	5.963205763
MTSS1L	0.034374305	2.189602608	EDN2	0.001098212	5.949913921
PRR4	0.011261504	2.175892069	SORCS1	0.001270518	5.937803159
FKBP5	0.036649291	2.17347459	ELAVL4	0.001098212	5.909721528
MICALCL	0.041270174	2.141271921	MEST	0.001098212	5.905897735
TSC22D1	0.046193465	2.133168902	KCNJ1	0.001391706	5.898983574
SLC19A2	0.021724556	2.119630562	TOX3	0.001098212	5.894297671

SOCS4	0.017151111	2.11566791	USH2A	0.002277115	5.893225024
ZFH3	0.040404538	2.09375996	HKDC1	0.002518505	5.863126774
PAPSS2	0.034117483	2.088521189	DISP3	0.001559518	5.861215328
TNFRSF11B	0.011121593	2.077609729	ITIH3	0.003114265	5.845283181
PPP1R3C	0.049568011	2.07200409	TLL10	0.000943693	5.838750668
KLF5	0.021355725	2.041792653	COL4A4	0.001098212	5.816333118
PLPP1	0.047389189	2.017130746	IKZF1	0.001098212	5.814601364
GOLGA6L9	0.021737482	2.014726622	XKR7	0.001098212	5.801344002
FOSL2	0.031989532	1.998881893	TPO	0.001098212	5.790175976
SLC7A2	0.008417687	1.985231021	ARPP21	0.001098212	5.776906425
HMGA1	0.037554223	1.980684862	CACNA1S	0.001413445	5.762072084
HS3ST3A1	0.006067936	1.968362351	MYCL	0.002266763	5.760103262
ARID5B	0.018305733	1.949388006	ANO2	0.001914691	5.755397611
ABCA1	0.009696061	1.941933537	FHOD3	0.001257521	5.746752843
SRSF5	0.045454203	1.9408897	RYR2	0.008615202	5.732012815
RAB11FIP2	0.020822913	1.939394943	ANKRD33	0.000907108	5.723579887
AKT3	0.037611537	1.90659422	SCN10A	0.001098212	5.700288947
SHISA3	0.016377123	1.902166685	CGB2	0.00130328	5.691281162
DUSP16	0.031597682	1.893946756	MUC5AC	0.001098212	5.690252552
TOB2	0.037392526	1.892816805	CARD11	0.002678295	5.669572151
ELL2	0.020397212	1.8923844	RBM46	0.001098212	5.667370233
SLC39A14	0.046441546	1.89169209	DSCAM	0.001109021	5.656574382
WISP2	0.014087449	1.878659613	PGLYRP2	0.001098212	5.654667668
ACADL	0.004484873	1.867341161	MYO18B	0.002485084	5.646195943
ITGA10	0.028950403	1.862692622	KLHDC7A	0.001098212	5.632384952
EMP1	0.046578837	1.84688413	CPNE4	0.001109021	5.628816231
H1FO	0.036909774	1.846262686	IGSF10	0.001559518	5.61629979
CEBPB	0.048623898	1.845665843	MYOCD	0.001947692	5.605083371
SH3D21	0.008936407	1.837263462	ATG9B	0.001098212	5.594357254
ZFP36L1	0.043458667	1.833313688	DLK1	0.001229282	5.584909702
CDKN1A	0.02008182	1.817895234	CCDC60	0.00130328	5.568481447
SNRNP70	0.046880583	1.816729129	TSHR	0.001758484	5.564440713
FAM46A	0.03998083	1.814847569	BPIFB2	0.001270518	5.560178442
GSN	0.008864848	1.809845795	CPLX2	0.001559518	5.559277409
CLVS2	0.022584239	1.805508567	SLC22A31	0.001098212	5.557378391
NFKBIZ	0.043501265	1.798394542	OTP	0.007927026	5.555020082

ATP1A1	0.041075339	1.79565401	COL6A5	0.001391706	5.553811204
PABPC1	0.042108084	1.791731791	UGT1A6	0.001098212	5.545828256
NKD1	0.039979533	1.790454824	PRDM13	0.000907108	5.530035883
PRRC2C	0.035478324	1.750618498	ARSI	0.001109021	5.527793559
FBRSL1	0.02669223	1.749710391	PRAME	0.001302819	5.523334579
CRYAB	0.034746916	1.738410563	GABRA5	0.002032099	5.521544773
SLC4A7	0.04632898	1.732407949	CD5	0.001082995	5.52062372
TBX15	0.042179781	1.723108478	WNT7A	0.001098212	5.51876106
ATN1	0.048530058	1.717626837	UMOD	0.006706412	5.517084207
DPYSL3	0.018616571	1.714009514	COL17A1	0.009074467	5.516236177
YBX3	0.04659258	1.70980194	GRIN1	0.003752596	5.506969577
KCNMA1	0.009074467	1.709470427	GUCY1A2	0.001438966	5.506341893
FRY	0.018725777	1.705177172	LHFPL4	0.001109021	5.505618693
GYS1	0.033586464	1.700310959	SELE	0.000907108	5.484334655
SMC5	0.038305007	1.700005119	AVPR1B	0.001270518	5.480237831
MKLN1	0.010105218	1.695638592	PPP1R16B	0.002974993	5.478501242
COPA	0.02938624	1.69519667	CBX2	0.001435796	5.471724768
OSBPL5	0.028500286	1.690830271	COL4A3	0.004932911	5.470976562
MFGE8	0.038160661	1.687808442	MNX1	0.001109021	5.469018226
DDX17	0.043802168	1.682082518	MYH7	0.001573628	5.468696601
AQR	0.010855971	1.67512207	FAT3	0.002009628	5.463600407
ARGLU1	0.03924128	1.673381967	PCSK5	0.001988926	5.461837962
CTTNBP2	0.017669286	1.67228224	ZIC2	0.000907108	5.461679636
ATP1B3	0.030436004	1.671956703	KRT85	0.001098212	5.460585488
MBNL1	0.034513072	1.671047182	C11orf45	0.001257521	5.459700253
CMSS1	0.041270174	1.664385736	ASCL2	0.001800777	5.457901682
ZC3H12A	0.024307485	1.654344743	MEGF11	0.001944651	5.452960042
SEC61A1	0.035299897	1.648392184	CDH16	0.001270518	5.452019558
LY6G5B	0.042095207	1.647701576	SCRT2	0.001116654	5.445114091
BTG1	0.043631304	1.641753277	NKX6-3	0.001098212	5.428589292
GALNT15	0.028456481	1.639620047	RASGRF1	0.001891438	5.426706752
ITGA5	0.009561345	1.618680374	NTSR1	0.001098212	5.422381206
PCF11	0.035239517	1.599020604	SLC17A8	0.001098212	5.417028035
TUBB2A	0.017434885	1.598935827	VSIG2	0.001406187	5.399734315
PPP4R4	0.039175634	1.597620547	ZNF804B	0.003990498	5.390254468
LPGAT1	0.039785237	1.587260096	ADGRA1	0.001219685	5.387571245

PTRF	0.043563428	1.570053296	ZDHHC22	0.002485084	5.375415922
SFMBT2	0.023888134	1.561073206	ABCC12	0.002277115	5.37479503
CBLB	0.027172148	1.558873369	GPR78	0.009191014	5.374700692
UBAP2L	0.03010129	1.55376185	AJAP1	0.005294101	5.36806154
HS3ST3B1	0.014901719	1.551197566	BCO1	0.001098212	5.366195792
NPIPB12	0.013187702	1.55069733	SLC34A1	0.005472473	5.357471603
AGL	0.04199409	1.54530122	COL22A1	0.008436918	5.34370788
PSME4	0.039175634	1.533322669	OR4N2	0.00188708	5.342978589
RBM39	0.040242695	1.522694065	TTC24	0.001109021	5.335314361
KANSL1L	0.01664201	1.520161847	TRPA1	0.002812669	5.33475588
SASH1	0.034442357	1.515697433	MS4A8	0.001348285	5.329867358
MKNK2	0.045144563	1.509504176	NKAIN1	0.007358983	5.329383222
C1orf21	0.015024385	1.507880862	THSD7B	0.008578961	5.325475691
TNS2	0.023765508	1.507128211	TMEFF2	0.006668101	5.323382497
HNRNPH1	0.038188232	1.507029985	ABCG2	0.002277115	5.321553395
MUC1	0.011724947	1.503560984	ROS1	0.008168973	5.315550986
CAPN2	0.018724393	1.501812146	MYH1	0.001098212	5.313077769
SRPK1	0.010855971	1.501768889	OGDHL	0.00188708	5.309913824
RAB1A	0.025169769	1.493796603	ALPL	0.001573628	5.309405525
HHAT	0.028964684	1.490448642	PLCB2	0.005582149	5.30045878
GPR89B	0.045988195	1.484942316	XIRP2	0.003752596	5.291442899
SLC25A37	0.044145576	1.48246372	HSPA12B	0.001886172	5.283838321
SLC26A2	0.046107085	1.480542175	DNAI2	0.00130328	5.282264712
NARS	0.026033484	1.479921423	KCNQ2	0.003752596	5.280295479
CBWD3	0.010515783	1.478980666	KCNK12	0.001863317	5.279779583
KANSL1	0.038148178	1.477613905	C8orf74	0.001555162	5.267997364
TPST1	0.017601263	1.476922949	CAMK1G	0.001098212	5.263883655
RAPGEF2	0.043830946	1.472600466	TMEM163	0.001257521	5.259440087
TMOD1	0.046251894	1.464385876	SLC1A7	0.001818536	5.257046561
SMURF1	0.048502959	1.463721187	THEG	0.001098212	5.256417983
ADPRHL1	0.046880583	1.461387426	RAX	0.009442815	5.247524297
SETD5	0.048623898	1.458453968	KCNH2	0.001270518	5.244943142
S100A6	0.039815078	1.45476238	NR1H4	0.001712362	5.240763395
RP11-514P8.6	0.017612896	1.453527944	FA2H	0.001825737	5.233055065
AKNA	0.024522563	1.453298677	PRR15	0.00130328	5.232716626
LPCAT3	0.008436918	1.451259797	SHISA6	0.001940993	5.23043764

SEC23IP	0.020172069	1.447927806	LGI1	0.003707836	5.230187929
WDR60	0.034210304	1.447292211	NRAP	0.001219685	5.227836808
SFSWAP	0.038728497	1.446658532	PPP3R2	0.003614605	5.225960339
NEBL	0.022021837	1.442832684	ASB10	0.001109021	5.223528845
ERICH1	0.046251894	1.437600377	EGF	0.004700467	5.216490099
WSB1	0.021079584	1.433337717	GIMAP8	0.001385184	5.216133986
NUMBL	0.020822913	1.43219378	KLK1	0.001219685	5.214855317
SELENOP	0.019436198	1.429400576	DNAH17	0.007390988	5.209401581
KMT2A	0.028786629	1.426135804	CNTN4	0.001098212	5.200955627
MXI1	0.044448914	1.424607494	RBP3	0.001109021	5.200248582
SESN1	0.023865144	1.417337767	MYO7B	0.001257521	5.198492179
SYNJ1	0.030586183	1.414338036	CCDC178	0.001800777	5.196393486
ZNF282	0.042108084	1.414245552	FCGR3A	0.001825737	5.187457813
ATXN7	0.010581015	1.413626022	FNDC10	0.001859794	5.187121357
B4GALT7	0.034513072	1.401266629	USH1G	0.005715706	5.18702243
HIPK2	0.027228495	1.397781582	GVQW2	0.001555162	5.185690063
GABARAPL1	0.036683651	1.396450975	CYP4F2	0.00130328	5.18266146
GOLGB1	0.02925575	1.395399611	MYH6	0.00377093	5.17752967
GPT2	0.043364301	1.394086958	GALNTL6	0.001712362	5.175156815
SEC31A	0.043282116	1.392224013	SCNN1B	0.002277115	5.168810878
WDR43	0.037684342	1.380015361	BCL6B	0.007563643	5.165294812
ELL	0.013763511	1.379662858	TACR1	0.001573628	5.163199455
NPIP3	0.014807355	1.377396933	MRGPRX1	0.001109021	5.15711248
IL6R	0.019482695	1.377378989	RP11-766F14.2	0.001712362	5.1539894
EWSR1	0.036649291	1.373661344	NPAS1	0.001624613	5.15193558
ZMYND8	0.042395106	1.372881422	PTPRQ	0.004737235	5.150898373
FBXO11	0.046828942	1.37098675	CARMIL2	0.021373617	5.149613712
PMP22	0.029523524	1.368771046	CACNG4	0.001098212	5.143706228
LRRFIP2	0.01925732	1.368447429	C10orf128	0.001947692	5.139009096
PRKAG2	0.03660632	1.367192346	SMTNL2	0.001863317	5.137361624
CNOT8	0.04711586	1.365657773	ASTN1	0.003977521	5.133676294
PRUNE2	0.028608073	1.363230658	CKMT1B	0.001300132	5.133044873
LUC7L2	0.024522563	1.362550973	SLC22A12	0.001465894	5.131289971
ZNF385A	0.035981192	1.362518701	ANO3	0.002509996	5.122855324
AASS	0.035638247	1.360782931	MUC5B	0.014849303	5.120429934
IQGAP1	0.019808902	1.354067604	IL17REL	0.003699197	5.118373456

AHI1	0.043939761	1.350900157	MAJIN	0.002009628	5.112749804
LONRF1	0.018690312	1.349180732	POTEG	0.00261761	5.110763029
SAFB	0.025143726	1.347270209	PDGFB	0.004667322	5.1087567
MADD	0.012256362	1.345377011	SLC5A7	0.001825737	5.106875669
FNIP1	0.026033484	1.344677964	CDCA2	0.001881455	5.103804938
GLTSCR2	0.044050528	1.343545207	B3GNT6	0.001219685	5.102239664
MYO9B	0.030213196	1.340445176	IMPG1	0.007962204	5.101598766
GLIS3	0.008168973	1.340019341	BCL11B	0.001098212	5.098603291
COBLL1	0.03697718	1.336986579	CNTNAP2	0.011406446	5.097227682
AUTS2	0.044376925	1.335803006	GRB7	0.003752596	5.094853152
KDM7A	0.040242695	1.334845302	KDM4E	0.001435796	5.09398101
ZNF841	0.028653619	1.334729791	KCNH7	0.001859794	5.093665171
TNKS1BP1	0.025143726	1.333382673	USP17L2	0.005872829	5.092661037
TMEM106A	0.044712981	1.330116546	DMRTB1	0.001825737	5.087516315
MIB1	0.030029686	1.328852806	AMPD1	0.00445506	5.083897556
POFUT2	0.041266332	1.328481526	DTHD1	0.00322086	5.0791317
USP53	0.048919045	1.327993866	RHCG	0.001270518	5.078446182
SRSF11	0.026976422	1.326261782	KLHL33	0.00188708	5.071751905
PAN2	0.042226254	1.326084626	ABCG4	0.002277115	5.071667427
MTMR7	0.04199409	1.32139207	KLK3	0.00130328	5.069055784
CASC3	0.04383848	1.316491692	C6orf201	0.00377093	5.060434248
EIF4A3	0.03024687	1.315641659	SLC6A3	0.00261761	5.059097188
SNED1	0.042157355	1.315303994	GPR139	0.001914691	5.058902497
TCERG1	0.031597682	1.313865573	SCN3A	0.015754494	5.043319915
RBM28	0.042179781	1.306913702	CTB-133G6.1	0.002354053	5.040414761
IBTK	0.041224353	1.303479262	MYT1L	0.000907108	5.038800135
SORBS3	0.04383848	1.303217251	SLA	0.008665547	5.035289071
EMSY	0.020822913	1.299036226	CFAP100	0.011613548	5.033811227
BDH1	0.045814496	1.286420902	C8B	0.00361749	5.033136283
GORAB	0.030029472	1.286136919	PCSK9	0.002233362	5.032530313
MALT1	0.028116131	1.281462211	CHRNA3	0.001863317	5.021267914
TNIP1	0.018978261	1.278373938	CADPS	0.001270518	5.019754837
ANKRD28	0.03143521	1.278022235	MCHR1	0.003719784	5.019312906
PABPN1	0.0462176	1.273386644	EPX	0.006285603	5.018958004
PPME1	0.044805197	1.270752688	GRM5	0.002285614	5.011671892
PPFIA1	0.030380343	1.269463577	CCDC144NL	0.001800777	5.007761853

HDLBP	0.04553273	1.268867932	PSG6	0.004171012	5.006718997
ANXA5	0.037611537	1.267657764	FOXE1	0.00130328	5.004690831
AKAP9	0.023888134	1.267451155	RAG2	0.002262565	5.000029499
TACC1	0.034247289	1.265661186	ECEL1	0.003285049	4.993426358
ATXN2	0.027654826	1.265372555	RNF182	0.009931228	4.98796644
SEMA4A	0.02772875	1.26386212	NGFR	0.003285049	4.987682282
PHF20L1	0.038305007	1.260046368	ZAN	0.017691706	4.98737387
ARHGEF19	0.022584239	1.256978015	ATP4A	0.005153697	4.987180073
TROVE2	0.04069104	1.256276742	SEZ6L	0.001988926	4.986949264
NDRG2	0.042946809	1.252220154	PCDH7	0.001098212	4.981798786
STK38	0.020763684	1.251905357	FGA	0.004807471	4.979444302
MCCC2	0.04014665	1.250514156	FCGR3B	0.003699197	4.978749472
WDR91	0.04165762	1.248622388	ANO4	0.001348285	4.976237052
ZNF638	0.048096323	1.245970366	BARHL2	0.008909747	4.973689231
PPP1R15A	0.042179781	1.244264956	HPD	0.002058693	4.972097171
SAMD4B	0.02936103	1.242337283	MYO3A	0.010855971	4.971829305
STAT3	0.040194271	1.240659688	PADI3	0.001098212	4.971604495
ITPR3	0.030726281	1.240087474	DNAJB8	0.001863317	4.967738812
SMTN	0.048862168	1.239054329	MMP28	0.00317268	4.967678595
RNF146	0.028950403	1.238586589	ZBED2	0.001413445	4.966551697
PIBF1	0.025233043	1.235180181	TRIM67	0.007284527	4.965743675
STX7	0.042395106	1.233031903	CPNE6	0.002009628	4.960755589
CAPN7	0.048574974	1.232991255	RXRG	0.001199867	4.9499696
SEC16A	0.038786914	1.232449018	KRT6B	0.010766991	4.947313834
DSCAML1	0.032913449	1.230165199	ADAMTS8	0.009614159	4.946010974
ACTR1B	0.031597682	1.228778573	JAML	0.008309788	4.945931692
TCAF1	0.043327116	1.22669069	EMX1	0.002611763	4.944414809
ZC3H14	0.04244593	1.226100003	SLC6A19	0.002097516	4.932191115
NPIP4	0.011816522	1.224571514	SULT4A1	0.007563643	4.931485898
RBM25	0.043327116	1.221539585	BPIFA2	0.00357002	4.925116468
ZNF783	0.047954934	1.221125736	CKMT2	0.006402439	4.919829765
USP13	0.020987669	1.220925338	CCDC63	0.002518505	4.917744887
SLC25A28	0.045352675	1.215924528	TMCC3	0.001947692	4.917331381
SRSF4	0.035262358	1.214207518	ATP2B2	0.007756243	4.915494755
TRA2A	0.04741087	1.213778563	CHRNA4	0.005872829	4.914794384
ZNF721	0.026976422	1.213238968	FAM151A	0.002493786	4.913582569

OAZ2	0.049175045	1.212520363	DOCK2	0.009557659	4.90948691
TCF25	0.036623533	1.205715316	SLC13A2	0.001521974	4.906988594
KLHL21	0.028281772	1.205675954	TSPEAR	0.002509996	4.906860843
ASL	0.022021837	1.205556864	KCNS2	0.002487619	4.905869669
NOP58	0.016232331	1.203142875	GJA5	0.01404091	4.90056035
KIF16B	0.041826871	1.201585733	MYLK2	0.001199867	4.897452874
ARIH1	0.027633653	1.200974576	VWF	0.005715706	4.896753883
RNF168	0.034728496	1.197840563	EVA1A	0.004674322	4.893476752
CDC42SE1	0.047756021	1.194494088	MYOD1	0.001944651	4.889753745
SORBS1	0.038292773	1.194376608	DPYS	0.004124374	4.885685694
PACSIN2	0.03187296	1.193654652	SNAP25	0.003752596	4.884990072
KLC1	0.049657674	1.192137019	SPDYE1	0.001435796	4.877456109
PDE4DIP	0.037053654	1.191469348	SPINK5	0.003169733	4.876547735
CREBBP	0.03222394	1.189403267	OSM	0.001947692	4.875568235
CYB5R2	0.040966724	1.189369575	C6orf222	0.001933241	4.87279284
MTCH1	0.019157151	1.188824045	SLC6A5	0.002918453	4.866137741
TMBIM1	0.040265619	1.182519208	FAM92B	0.001348285	4.863335853
HIP1	0.048454027	1.17977456	DUX4	0.003874063	4.861865747
SCAF4	0.029154877	1.178330761	LOXHD1	0.001398736	4.856909471
TNPO2	0.04296147	1.177960462	GRAP2	0.025213475	4.85633186
ZCCHC6	0.04069104	1.177126508	CAPN11	0.005086774	4.854148118
FEM1C	0.022624407	1.176706982	ADAMTS19	0.010635331	4.853307738
TMEM165	0.036084921	1.173753852	PDE9A	0.003588759	4.85325526
AMIGO3	0.027116427	1.172438547	THEMIS	0.001944651	4.852746293
PYGL	0.021737482	1.171103313	INSM2	0.002277115	4.851103975
CSNK1D	0.024315816	1.170781562	CNTNAP4	0.019300088	4.850496046
U2AF2	0.045814496	1.169507635	ANKRD34B	0.004667322	4.843107131
FPGS	0.045798548	1.165024631	SHH	0.005086774	4.837878699
TMEM214	0.02468978	1.163954194	CLRN1	0.001098212	4.837683092
TEP1	0.03665743	1.16239153	GPR182	0.00236758	4.835507051
DYRK1A	0.044145576	1.16136663	SLCO5A1	0.004574148	4.834699095
FZR1	0.040473137	1.160806587	AQP2	0.00277198	4.833516772
NKTR	0.040404538	1.159305433	PRR20C	0.005715706	4.831899841
NISCH	0.023451351	1.156994168	TP73	0.005352304	4.829422133
AP1G1	0.041993567	1.155711392	NR5A1	0.001972068	4.828781103
ACTN4	0.042412359	1.154587927	KRT3	0.00130328	4.828273159

SENP5	0.0427733	1.15402757	KRT16	0.010251671	4.827288302
CDK9	0.046276534	1.150353282	PCDH8	0.011889341	4.826999809
WDR3	0.031019531	1.149925999	ASXL3	0.003383407	4.825119923
ZSWIM8	0.045988195	1.147046239	GFI1	0.010071831	4.822612891
MSI2	0.043458667	1.146393575	MMP20	0.002918453	4.821707008
PPM1B	0.034631683	1.141966822	CRB3	0.001804147	4.821320662
SMARCA2	0.025213683	1.136144261	PTPRN	0.00261761	4.820549976
NPIP5	0.039964574	1.135260974	SLFN14	0.001270518	4.820306744
NPIP11	0.026806925	1.122529524	SFTPA2	0.002277115	4.815910748
YAF2	0.04048315	1.117221516	ARHGAP40	0.011974966	4.814685985
TOM1	0.031597682	1.111751056	ADAMTSL5	0.004171012	4.814242801
FMN1	0.042108084	1.109518007	NWD2	0.01296248	4.812153207
NPIP13	0.039171252	1.10874638	FOLR3	0.001886172	4.809748807
DCAF8	0.028959282	1.107377705	PGA4	0.003168377	4.808863388
MAP7D1	0.04642451	1.103767991	GIMAP4	0.002918453	4.808486588
LMF2	0.03891096	1.102585809	FETUB	0.008502829	4.807052064
INO80D	0.04659258	1.102307353	PSG11	0.009557659	4.805590894
SPATA6	0.03068145	1.094079414	RXFP1	0.001385184	4.802392523
ERAP1	0.048994512	1.093120555	RLBP1	0.009274205	4.800275322
BCKDHB	0.036823982	1.090569671	CFC1	0.00188708	4.797899327
SS18L1	0.047267162	1.089043302	WDR87	0.003022595	4.795696272
NAPA	0.04250031	1.087370248	TMPRSS9	0.003696065	4.795368549
AGAP6	0.047441751	1.086228843	SH2D1B	0.003268599	4.783820444
EOGT	0.02633916	1.083427737	CHRNA6	0.002009628	4.783451064
STK24	0.045272335	1.081182869	GJB3	0.002009628	4.781404002
YWHAH	0.046578837	1.079128593	RDH12	0.002009628	4.77938888
POLR2J3	0.047861107	1.077883012	IGFN1	0.017060098	4.777157752
SETX	0.028924712	1.07538634	SALL3	0.012694725	4.767330055
BAZ2A	0.042395106	1.073145881	C2orf71	0.00670064	4.761636323
EIF4A1	0.035789771	1.072083402	SLC27A2	0.008102389	4.757151891
SIN3A	0.035047213	1.070629692	DRD1	0.005056309	4.754333833
OSER1	0.046251894	1.067118345	SLCO2B1	0.004807471	4.753797005
ABL1	0.045144563	1.06618123	PCDHA13	0.001973726	4.751344823
STAT5B	0.040536958	1.063440818	CYP1A1	0.001098212	4.75090697
LUC7L	0.030676254	1.062380303	FAM189A1	0.011938646	4.749933665
PTPRG	0.039964574	1.060866811	LYPD6B	0.00261761	4.74978557

ZNF266	0.044652225	1.056894403	NLRC3	0.001886172	4.748703968
MCTP2	0.039755801	1.054334604	KRT77	0.002533812	4.7465111
TVP23C	0.041179394	1.050174511	HPSE2	0.002485084	4.743660767
CEP63	0.041581717	1.045290603	FBN2	0.020822913	4.739459807
FBXO42	0.031977215	1.038812385	NUTM2G	0.00188708	4.738786302
RNF31	0.027633653	1.03338765	CCDC188	0.001857007	4.738121563
METTL16	0.043830946	1.028837893	EPHA8	0.003285049	4.736280623
EFCAB1	0.045454203	1.026899938	RAG1	0.005290573	4.734588933
MTMR3	0.046828942	1.025063794	SSC4D	0.004569339	4.732073795
DHX15	0.040404538	1.021747117	SPATA31D1	0.006197788	4.729439526
EP300	0.045537885	1.021299507	KCNV2	0.001825737	4.726161862
ANTXR2	0.044887925	1.017695962	CD8A	0.008577972	4.723890059
SND1	0.036130832	1.014848855	SERPINB13	0.003752596	4.720386986
CCNK	0.036084921	1.002674551	ZNF536	0.002009628	4.717768157
ASXL1	0.03352273	1.001805506	DNAAF3	0.00188708	4.71437315
CLK2	0.044989407	0.995547274	CWH43	0.001712362	4.71174779
GPATCH8	0.047525421	0.995492137	CLDN19	0.00178501	4.710877897
CRTC2	0.039294744	0.993615351	TRPC7	0.002905025	4.710321255
ZNF326	0.023654834	0.990905795	HTR7	0.00447874	4.707893933
TRABD	0.04165762	0.990335449	MEP1A	0.0080853	4.705584745
ABCF3	0.034513072	0.982542287	MYH2	0.010855971	4.70461446
SAP30BP	0.038786914	0.972432806	SUN5	0.00261761	4.701158958
GOLGA4	0.044805197	0.966826369	PIRT	0.002277115	4.699819525
PPP6R2	0.046283742	0.961824566	OCSTAMP	0.002485084	4.698157711
GMPPB	0.045272335	0.960836184	ZP4	0.00305044	4.693757668
GABPB2	0.049172728	0.95725764	C12orf42	0.011834336	4.689900496
ARFGAP3	0.047650269	0.953204297	HABP2	0.005715706	4.688954525
POMGNT1	0.044652225	0.951642523	TP53TG3	0.003970356	4.686098996
ADAM17	0.045459049	0.947157631	LRRC4B	0.002918453	4.685112827
ZFC3H1	0.04199409	0.927250471	VTCN1	0.003285049	4.683013899
EIF4G1	0.049945735	0.919193851	INSRR	0.016870554	4.681321249
DUS1L	0.04659258	0.91802603	WNT3A	0.00236758	4.681306229
PI4KB	0.045810037	0.902182083	DCAF4L2	0.01409258	4.678724657
NCOA1	0.044448914	0.888720425	RGS8	0.02938624	4.673690794
			IRX6	0.013384037	4.668674359
			MYRIP	0.005008576	4.668508408

SLC6A2	0.007574062	4.667035258
UBASH3A	0.002044693	4.665721651
RFX6	0.012537803	4.661379444
TUBB8	0.009919351	4.661170039
CDC25C	0.011681909	4.65858708
DBH	0.004601729	4.657360197
GIPC3	0.009220588	4.655944429
SORCS3	0.036298078	4.65510412
NPBWR1	0.00235224	4.653170422
CAMKV	0.012011123	4.648526675
SLC2A7	0.00717585	4.647152141
TUBB1	0.00377093	4.646347102
MUC13	0.017279842	4.645919514
LA16c-380H5.3	0.002819064	4.643193867
LTK	0.002300503	4.640639769
CDCA7	0.0187171	4.640335555
LGALS9C	0.005542175	4.636825275
NELL2	0.012449408	4.634818405
PKP1	0.008665547	4.63359714
OTOP2	0.009076274	4.632994536
ETNPPL	0.001972068	4.632574313
CEACAM7	0.001640384	4.627601285
FLG	0.00233562	4.623224029
ELF5	0.010548865	4.622432012
ADGRF4	0.006528458	4.616454325
PRSS33	0.002611763	4.615463157
HOXB4	0.002459419	4.614953713
CD177	0.004606221	4.611686758
ABCG8	0.003752596	4.609877911
LRTM2	0.004771302	4.608963201
LGI3	0.00725377	4.60795148
HCN4	0.002458241	4.607500533
PNOC	0.006067936	4.604721651
GATA2	0.01497845	4.604440883
NAT8L	0.001712362	4.603483004
LRRTM1	0.004822456	4.601832527

KRT80	0.002918453	4.60168331
LACTBL1	0.004444952	4.601552676
CGB7	0.009877884	4.599448811
C2CD4C	0.00235224	4.59697677
PKP3	0.006452506	4.596940875
DAB1	0.003643002	4.590469911
GPRIN2	0.002918453	4.586487167
UNC13A	0.005909571	4.585096433
TRPM1	0.00417462	4.584677632
DPEP3	0.006403317	4.583133824
NOL4	0.011902119	4.582022589
WDFY4	0.015959206	4.577935312
GABRG1	0.012536394	4.577012431
SYT3	0.00354035	4.569619358
UNC5A	0.00508364	4.567110887
SMTNL1	0.001790472	4.566807214
SLC17A6	0.014949848	4.563110915
MUC12	0.009251262	4.561752389
RASGEF1C	0.007947817	4.560515847
HTR5A	0.006203148	4.560155458
SLC9A2	0.008578961	4.559559821
SLITRK1	0.001604752	4.557905109
RASGRP2	0.007720774	4.557665947
CDCA5	0.002044693	4.556716157
MYH8	0.007731525	4.556256476
TMPRSS6	0.006077388	4.55531173
TMIGD2	0.00291098	4.552423091
SLC26A9	0.003751014	4.549351591
SERTM1	0.00261761	4.546895418
SLC6A1	0.012449408	4.546732263
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MROH2B	0.02002516	4.544181615
USP17L11	0.00417462	4.54323642
CALHM3	0.002327569	4.543048761
SLC25A47	0.003951163	4.541344952
GMNC	0.015742017	4.536618132

KRT2	0.003253721	4.535853272
GRIN2A	0.007977821	4.532431015
CCDC187	0.002974993	4.531563257
PRR36	0.004807471	4.527639447
CFAP65	0.003752596	4.526180915
NLRP13	0.011724947	4.522836473
PPM1E	0.004099312	4.522651068
KIF5C	0.002854383	4.522389165
ACE	0.001219685	4.52177105
CTNND2	0.003591243	4.521292956
MAPK4	0.005401711	4.518506492
PTGDR	0.007390988	4.517217232
NEUROD4	0.003699197	4.514027576
CLEC14A	0.002277115	4.512994704
XKR6	0.006389619	4.510049134
CA4	0.004666524	4.507036193
HTR1A	0.002044693	4.506750177
WNT5A	0.012096591	4.506374896
CHRM3	0.014350283	4.505116743
GRM3	0.028964684	4.502620372
NT5C1A	0.001435796	4.502318983
ZNF683	0.002327569	4.501728659
GATA5	0.002918453	4.501643024
CA10	0.012532328	4.498657536
KCNK9	0.003812737	4.498515861
DUOXA1	0.006863292	4.497047067
CCDC177	0.02938624	4.496427352
ALOXE3	0.003886291	4.495812001
ISL1	0.001982915	4.493142922
MYH4	0.004008189	4.493079429
LHX4	0.032996008	4.492047405
ZBED9	0.019767619	4.49152874
MMD2	0.005136025	4.489268252
ALDH3B2	0.023001749	4.485005761
BOLL	0.007466915	4.484233264
CXCL13	0.002533812	4.482229437

SBK2	0.003514892	4.48221035
TBC1D21	0.001756691	4.481071731
KIFC1	0.010581015	4.479821315
NPAS4	0.012096591	4.479378461
HS3ST5	0.005615761	4.478612967
FFAR3	0.014803836	4.478154663
TICRR	0.003932022	4.476945873
ENPP7	0.003240458	4.473374691
SHC3	0.010032857	4.470194592
ELOA2	0.010855971	4.467607749
FGF19	0.00188708	4.463657059
USH1C	0.007524436	4.46225095
NANOS2	0.001990118	4.458930737
CCDC27	0.003321333	4.458389655
CRYBA4	0.011902119	4.456954091
HAPLN4	0.020357836	4.456920938
CNTN2	0.02938624	4.456438479
DSG4	0.020039652	4.455897829
CPZ	0.01296248	4.452759548
CACNA1B	0.003854151	4.449259083
GLYATL1	0.006285603	4.447669956
GOLGA6L6	0.036729141	4.447121448
ALLC	0.012170459	4.446850515
C12orf74	0.001891438	4.439716931
TRPC4	0.010581015	4.437147826
KCNS1	0.001402833	4.435713872
ANKRD33B	0.003338984	4.433903998
CPB1	0.002493786	4.428978609
UNC5D	0.002006307	4.426952882
PRKAG3	0.007345997	4.426760887
KRT79	0.003739585	4.426279598
MUC6	0.006217257	4.420757458
ZIC5	0.009696061	4.418591092
KCNH5	0.003338984	4.417655954
SEMA3G	0.03352273	4.414943511
OR1J1	0.004569339	4.414581776

ADGRF5	0.001712362	4.414538589
RASGRP1	0.005695606	4.412257959
PSG7	0.011518961	4.412018699
SDR9C7	0.003752596	4.407410623
TTYH1	0.005795274	4.405914731
ALDH1A1	0.010581015	4.398957674
MCHR2	0.009696061	4.396213599
C10orf90	0.018064752	4.3950063
SPNS3	0.016589396	4.39333982
RFX4	0.002316538	4.392819217
TLDC2	0.002487619	4.391415448
SYT4	0.018809974	4.391398293
NDST4	0.003285049	4.390611055
CRHR2	0.006862531	4.39004672
SAMSN1	0.023516694	4.388145089
WNT1	0.002046985	4.386764912
SFTPA1	0.010581015	4.385137416
PIK3R6	0.004412771	4.383245708
CCR2	0.00377093	4.381149433
DIRAS3	0.003471626	4.381069773
BPIFB1	0.003470242	4.379819189
C22orf42	0.011997544	4.379801978
CASKIN1	0.031597682	4.377380125
TMEM132D	0.009191014	4.376546039
POU4F1	0.026429109	4.374102327
KRT35	0.002509996	4.372130628
KIAA1211L	0.026553543	4.369592301
CA7	0.01697189	4.368471457
SRD5A2	0.013009249	4.367628244
GPR26	0.006862531	4.363423891
MFNG	0.014542853	4.360876536
LRRC74A	0.006317439	4.360582667
SPHKAP	0.01392699	4.359725741
JAG2	0.010044099	4.359107318
KLHL1	0.015601712	4.35575046
TFEC	0.011044857	4.354713669

P2RX1	0.010581015	4.353437215
ITPKA	0.004118308	4.352634086
CHRNA	0.026368379	4.349880143
SLC22A10	0.004124374	4.347765289
CXCR5	0.002116982	4.347035819
TGM5	0.012211332	4.346903801
PLA2G2F	0.007574062	4.341017174
GAB4	0.004869255	4.340387676
OTOF	0.00761049	4.339677316
TMEM139	0.007766522	4.335577982
CDH2	0.015926238	4.334773839
ARHGAP30	0.01404091	4.334753383
GRID2	0.020428788	4.332339471
OPCML	0.035067872	4.331847191
FGF6	0.002889058	4.328243363
KRT13	0.006681182	4.328191877
LHX5	0.010105218	4.328183178
MARCH10	0.006681182	4.327909377
PARVG	0.002441883	4.32512187
CRMP1	0.003321333	4.324038096
FCGR1A	0.020822913	4.323253606
UNC93A	0.01296248	4.323130355
CLCA1	0.019436198	4.322204264
KRT24	0.003198707	4.320467897
ZNF671	0.013452526	4.319157163
PSMB11	0.011261504	4.316628675
GIMAP6	0.003266363	4.31566434
AATK	0.004568651	4.314710908
KRT1	0.004768726	4.312203412
CENPU	0.00377093	4.310379577
GPR20	0.004487568	4.303985241
TRIM54	0.010044099	4.303244452
TMEM132E	0.015497609	4.302072446
CAMSAP3	0.010717058	4.300248199
DNMT3L	0.010688549	4.29917855
OVOL1	0.008442181	4.297990067

ZBPB	0.014270759	4.296306188
SYT13	0.00371589	4.296213664
KCNJ18	0.009557659	4.295575057
FEV	0.002277115	4.295489034
DTX1	0.01610641	4.294083136
SEMA5B	0.002611763	4.292979254
NCAN	0.013724229	4.29278042
PTF1A	0.010105218	4.291909864
LYPD4	0.004444952	4.291204297
ARHGAP9	0.010044099	4.289979245
CDX2	0.004279556	4.287825541
JPH4	0.020822913	4.286505383
CD300LB	0.009280463	4.286224584
MUC17	0.015024385	4.284302921
KRT32	0.004444952	4.283756565
HHATL	0.003321333	4.281034093
ENTHD1	0.008502829	4.280463079
DACT2	0.006285603	4.277957816
GOLGA6L22	0.007470435	4.276297604
ACPT	0.005006158	4.271975518
LRRC7	0.011777062	4.268731844
SLC39A5	0.032956369	4.267802868
PRR20B	0.009220588	4.267371874
PRR20A	0.009220588	4.267371874
PRR20D	0.009220588	4.267371874
PRR20E	0.009220588	4.267371874
DUSP27	0.010394372	4.265660236
SNAP91	0.006747997	4.261549322
CPA2	0.003321333	4.261035239
DKK2	0.010769424	4.260237719
CATSPER1	0.005086774	4.258724161
B3GNT3	0.003888631	4.258707499
ITGB2	0.028456481	4.258355336
DRD2	0.010717058	4.255010012
GPRIN1	0.019239514	4.251843523
HRH3	0.007565963	4.251696231

SIGLEC9	0.012330693	4.25005417
P2RX2	0.014169206	4.248562505
ADGRG3	0.012532594	4.248508382
TBC1D28	0.025442744	4.248320927
MYRF	0.005301191	4.246828684
APLP1	0.001947692	4.244902747
CEND1	0.008094122	4.244779509
EDN3	0.013476945	4.244344221
DLX2	0.003614605	4.243575036
SLC6A18	0.003965281	4.243095021
CASP5	0.002485084	4.242023773
CFAP46	0.00178501	4.241195435
PDYN	0.00445506	4.240917358
HTR3A	0.037585815	4.240176856
FOXN4	0.016686998	4.239688211
SIX6	0.009595864	4.239529738
CHRNA9	0.012610965	4.238954304
MORC1	0.004807471	4.236122881
IL19	0.006681182	4.236028748
GRM8	0.025213683	4.232259612
ELOVL2	0.019482695	4.231168683
ST14	0.033606711	4.22913036
GAL3ST3	0.005325595	4.225799925
NPHS1	0.001109021	4.225472429
PDLIM1	0.006862531	4.224175143
RTN4RL2	0.010581015	4.223107751
NPR1	0.013149717	4.222604467
HOXB6	0.005699402	4.221673255
CEACAM20	0.004381908	4.220414098
BPIFB3	0.007078818	4.218105497
PSG4	0.020299588	4.216112506
PAX7	0.02615575	4.215819944
HOXB3	0.007466915	4.214630523
GABRA1	0.017743281	4.214420814
KRT36	0.007539833	4.213811613
NRG3	0.034250919	4.213581299

ANHX	0.007574062	4.212227154
FRMD5	0.047157333	4.21168348
DENND1C	0.007358983	4.210472491
SLC7A10	0.028175277	4.208490962
PTCHD4	0.006572914	4.207013292
GPR12	0.007861676	4.203767504
CCKBR	0.008936407	4.203104921
CSF2RB	0.008041855	4.200320861
SHISA7	0.015547548	4.196941273
ADAMTS18	0.003932022	4.196332751
PSG9	0.020039652	4.195757286
IRX4	0.034245771	4.194167528
CDRT1	0.002918453	4.191406286
TUSC5	0.008909747	4.19056826
SLC12A1	0.004932911	4.190332848
ADCY8	0.012980603	4.189985867
TEKT1	0.042582273	4.189788016
OIP5	0.007524436	4.189482153
LHX6	0.028950403	4.188840497
SPATA31E1	0.036248749	4.18859321
EPHA6	0.01983496	4.188561483
STMN2	0.006701539	4.188244503
FAM69C	0.021355725	4.187222276
PIK3R5	0.032120977	4.186979154
CALCR	0.003338984	4.186026433
LUZP2	0.021826662	4.184381247
MYBPC2	0.013284097	4.183123308
FCRL4	0.02772875	4.180659011
MMP9	0.031562899	4.179269235
ACKR1	0.018809974	4.177717786
SMCO3	0.002918453	4.176818407
TGM4	0.010855971	4.17560894
CCK	0.006264144	4.174983863
PRSS56	0.015169869	4.174629555
SYT6	0.02259052	4.168110772
LILRB1	0.002547854	4.167176998

BRINP1	0.023001749	4.164095302
DLL3	0.038305007	4.163280491
SLC30A10	0.005323779	4.162734257
GRIN3A	0.034728496	4.162434313
RAB3C	0.003310313	4.157418605
FGF12	0.001109021	4.15629136
ADAMTS12	0.011220813	4.153555187
PZP	0.011816522	4.152620621
NLRP6	0.007731525	4.151409694
C6	0.015890896	4.149360614
POM121L2	0.00508364	4.148572492
IL1R2	0.028899012	4.146518658
OPN5	0.029197493	4.145306675
PLA1A	0.015816938	4.144910502
GPR37	0.004932911	4.143610958
HDC	0.007524436	4.141383984
HOXC11	0.008114231	4.140953556
OTOP3	0.005582149	4.138977155
ANKFN1	0.009094365	4.137090881
BTBD18	0.01664201	4.137034613
KCNA5	0.02478851	4.135988911
LCN8	0.004574148	4.135972043
FGD3	0.034169242	4.13545978
CTD-2501B8.1	0.004137751	4.134462156
LIN28B	0.01925732	4.131149751
RIT2	0.010133989	4.130708866
MYO1A	0.003338984	4.130527113
ABCA12	0.031562899	4.129032794
GRK1	0.007927026	4.128526518
SALL1	0.038628528	4.12782674
AIPL1	0.006862531	4.125416418
LRRC52	0.001947692	4.123463435
APLNR	0.010855971	4.121418661
GRHL3	0.010855971	4.120755851
LPAR5	0.005373897	4.117441256
KRT7	0.005795274	4.115318557

SLAMF8	0.02792498	4.114391254
BIRC5	0.003511509	4.114053752
UGT3A2	0.035767964	4.112467104
NOX3	0.023550012	4.112296457
PRSS1	0.003559465	4.109189501
FGF21	0.008719813	4.108974335
CYP11B1	0.009573513	4.108772855
CCM2L	0.005457635	4.107844668
GJA3	0.004118308	4.106006948
NPTX1	0.040498281	4.105615
KCNF1	0.008468686	4.105203493
C3orf22	0.008417687	4.102062824
MGAM2	0.004020335	4.100909381
AMHR2	0.008436918	4.096604552
NEURL1B	0.005401711	4.095869469
ELOA3	0.032928107	4.094989541
SHBG	0.005715706	4.094344823
CELF3	0.012537803	4.094296022
ROBO4	0.017743281	4.09419586
PPM1H	0.004807471	4.093788772
GGT2	0.022018458	4.093199007
FRMD1	0.001712362	4.093115045
CXCL5	0.003752596	4.092692881
TCP10	0.009696061	4.092580529
SYT7	0.032123626	4.091466325
PIANP	0.028175277	4.088684137
LYPD6	0.016232331	4.088517622
SP5	0.017623713	4.088200837
GPIHBP1	0.005795274	4.086505024
PROC	0.022822403	4.08363289
TMEM82	0.020039652	4.082878141
ABCA4	0.002512025	4.076146532
NEURL3	0.010635331	4.075725066
C11orf16	0.018777261	4.074937137
IL27	0.008080856	4.073535182
MIOX	0.009560127	4.073403949

DMP1	0.003752596	4.073195018
LAD1	0.025169769	4.073065672
KIRREL2	0.0189778	4.070429716
DRD5	0.007668672	4.069626032
ANKRD18A	0.012854194	4.068265623
KCNIP4	0.009931228	4.066024435
SLC9C2	0.018809974	4.065385332
LGR5	0.010071831	4.064834689
EBF2	0.002918453	4.061570118
ZP1	0.04069104	4.061535661
TERT	0.038325009	4.059269635
PSG3	0.024307485	4.053258182
SLC8A3	0.007159351	4.052993061
SOX21	0.007434052	4.051040102
CUX2	0.019482695	4.050217331
SIRPB2	0.002900628	4.047207777
TM6SF1	0.016686998	4.042826417
CSPG5	0.009438081	4.042408305
DBX1	0.015100608	4.041307837
TMOD4	0.011558411	4.041073008
CALML3	0.007793313	4.040179288
KRT73	0.017669286	4.039541949
CHRNA3	0.012330693	4.039450774
PRODH2	0.005787642	4.035240259
TM4SF19	0.00377093	4.03314824
VWA2	0.01404091	4.032856946
CEACAM3	0.029665073	4.031474201
NDST3	0.005352304	4.030519547
GAS2L2	0.011560811	4.030321002
CHST8	0.003735555	4.030098779
ST6GALNAC5	0.024522563	4.028058364
ASPHD2	0.005505196	4.027401758
TSKS	0.010766991	4.025904137
TMIGD3	0.012993435	4.025783257
TLL8	0.015762109	4.025771181
RP11-546B8.6	0.017271026	4.025287543

DUSP26	0.013853996	4.024019341
KIF2B	0.019031258	4.022102854
S1PR5	0.025233043	4.021138714
FSTL5	0.02209706	4.02096544
C3orf30	0.0080853	4.020249632
DQX1	0.010902346	4.016042153
PCDHA11	0.011518961	4.015837083
KRTAP10-11	0.013791275	4.013830112
ADAMTS20	0.020259258	4.012401818
KCNH4	0.018725777	4.010700448
NPTX2	0.008936407	4.008954051
THEM5	0.012532328	4.008708559
SLC17A2	0.010581015	4.002716511
ALDH3A1	0.003614605	4.002638827
C14orf180	0.009696061	4.00223996
SDPR	0.009251262	3.997656498
POLQ	0.009560127	3.997461215
TMEM217	0.013763511	3.997329552
LYPD8	0.007011262	3.995728604
GALNT14	0.007639386	3.994898434
PRDM12	0.014994626	3.993694074
POTEB3	0.028995898	3.991640936
HGF	0.047690928	3.990712914
GSDMC	0.022641444	3.990234077
CLDN6	0.003888631	3.988813075
FLT3	0.006681182	3.988105874
OPALIN	0.021562511	3.987494659
PRSS16	0.008436918	3.98724929
DNAH10	0.010769424	3.986764878
PPP1R9A	0.016836127	3.985866065
FRG2B	0.021161439	3.985790336
RGS7BP	0.021605536	3.982859338
TFAP2B	0.040376593	3.982456983
KRT83	0.008912632	3.978616625
LMX1A	0.021050675	3.976840655
PCDHA12	0.030245733	3.976367435

GNA15	0.010598464	3.974779036
FSHR	0.021193915	3.972956501
CDH9	0.004674322	3.972161986
ALK	0.003854151	3.968861785
MOGAT2	0.012449408	3.968392814
MMP8	0.008112278	3.968038089
LPA	0.002485084	3.965085295
FCER2	0.031771259	3.964263726
SYNDIG1	0.026992157	3.962067225
CACNG7	0.012205173	3.96139071
LRRC3B	0.008616294	3.960055647
KCNK17	0.010259605	3.958053427
KRT5	0.016883312	3.957446158
PI15	0.046828942	3.956840886
RP11-96L14.7	0.027899788	3.955405368
NECAB1	0.012551277	3.955332622
INSL4	0.028899012	3.953699969
LRRC14B	0.005143678	3.953692526
KRT81	0.016408611	3.952691876
RBFOX1	0.045471478	3.951033675
CD48	0.032608043	3.949024444
NCKAP5	0.007565963	3.94784049
CACNG2	0.036084921	3.947667236
PADI1	0.01955943	3.947212801
SHD	0.022018458	3.942839407
IQGAP3	0.008436918	3.939764529
WT1	0.038723381	3.939569901
GPA33	0.004695934	3.936316637
TGM6	0.028608073	3.934588233
SAPCD2	0.010978997	3.93428331
PRF1	0.006067936	3.933645019
LRCOL1	0.006844077	3.931402122
CNTN5	0.013349591	3.928403243
CDH5	0.007434052	3.92697367
KCNG3	0.020270242	3.926311341
SFTPC	0.023001749	3.923204615

SRMS	0.019482695	3.92253846
VSX2	0.005180657	3.921902964
SOWAHA	0.007390988	3.921842023
ADGRG5	0.016156553	3.919680028
HSD3B1	0.011128196	3.918847384
CBLN2	0.010581015	3.916334243
SIT1	0.007766522	3.913133309
YPEL4	0.026199972	3.911360736
ILDR2	0.002278407	3.911028174
TNNI1	0.006526226	3.908296484
ITGAD	0.026948181	3.906541996
CYP19A1	0.005626409	3.906229577
KCNJ4	0.003699197	3.905987444
ITIH2	0.022018458	3.905465448
EFCC1	0.018064752	3.901904138
RP11-509I21.2	0.008436918	3.900276398
TEK	0.013104693	3.897927236
FAM205C	0.006487641	3.897880511
IRX3	0.048783907	3.896957747
ACTL6B	0.033606711	3.894558252
EBI3	0.007078818	3.893911829
VGFB	0.023001749	3.89226687
DLGAP5	0.019319585	3.889892537
HTR4	0.014579037	3.888645867
LEMD1	0.010855971	3.888057992
ACTRT2	0.00445506	3.888003117
SLC32A1	0.010506588	3.885850232
KCNT1	0.008930864	3.88560203
FAM3D	0.007390988	3.88518987
HPCAL4	0.02015438	3.883669823
TCHHL1	0.035738373	3.880377053
IFITM5	0.011135886	3.879979418
HYAL4	0.003156038	3.878392015
SSTR3	0.023531055	3.878045068
PRMT8	0.017882724	3.877635153
SHC2	0.007390988	3.877128526

GSX2	0.004807471	3.877080351
SLC7A4	0.013122825	3.877061838
GPRC6A	0.028230045	3.874440671
OLIG3	0.011137621	3.869589769
HCK	0.007927026	3.868392336
SCTR	0.015922795	3.868119056
ASGR2	0.011816522	3.86410518
LCP1	0.01404091	3.862828561
KRT75	0.027323034	3.862640784
CYP24A1	0.031019531	3.862141807
PRNT	0.013182481	3.86157735
KRT71	0.046909016	3.860318886
C16orf59	0.019157151	3.858643346
SPDYE2B	0.007345997	3.858338124
ALOX15	0.008147081	3.858154248
DPEP1	0.013722045	3.856483231
ADAM30	0.017684793	3.856453297
MMP15	0.032120977	3.855667667
ODF3	0.022018458	3.855463483
CLCNKB	0.006681182	3.855214472
NPSR1	0.009919351	3.853080694
SV2C	0.015533546	3.851810849
LMAN1L	0.005415807	3.84889894
DRC7	0.002918453	3.847267598
RDH8	0.010105218	3.846155849
CD36	0.019998588	3.843284784
APCDD1L	0.016393174	3.841139555
ACMSD	0.028589285	3.83764751
SAMD10	0.030043031	3.836773337
CDC45	0.031193592	3.836421902
ACHE	0.014566113	3.831093319
ASCL1	0.005265405	3.828188183
RIPPLY2	0.01527547	3.827974598
SHCBP1L	0.007574062	3.827859378
MRGPRX4	0.012250847	3.827655539
RASAL3	0.016743372	3.827274579

NHLH2	0.028939435	3.826484243
DRC1	0.02684106	3.824453675
CHAT	0.027899788	3.823873454
TKTL2	0.017691706	3.822814581
ANLN	0.010855971	3.822591542
ATP6V0A4	0.023873296	3.821609861
TRPM2	0.017375421	3.819754842
NUTM2F	0.017684793	3.819523182
RTL1	0.045272335	3.81807821
EVX1	0.006895293	3.817269102
UGT3A1	0.006592803	3.81710952
WNT8B	0.028990069	3.814547463
PCDHAC2	0.015755648	3.814166209
PAK6	0.003806303	3.81414583
FCN3	0.017601372	3.813467081
CSMD1	0.005977652	3.81244031
NLRP5	0.019540134	3.811569079
SLC16A14	0.013181727	3.810441528
PPP1R17	0.02684106	3.810096066
RASSF10	0.025032662	3.807682912
ITGA4	0.018690312	3.806700839
KLK14	0.017684793	3.806473433
KRT76	0.008041855	3.804233511
VAX1	0.003338984	3.803699221
CKM	0.013600301	3.803464623
FOXS1	0.025032662	3.803369785
VSTM2L	0.011600762	3.801909279
PAH	0.016232331	3.801608011
VIPR2	0.019211767	3.801495954
NLRC4	0.037926514	3.798922423
PKIA	0.020039652	3.797758205
ADAMTS14	0.004569339	3.797304273
HEYL	0.028887091	3.793133812
RP11-506B6.7	0.015762109	3.792132017
TMEM61	0.027223102	3.791930609
VIL1	0.013416537	3.788540407

SAMD7	0.007947817	3.787795709
TRIM55	0.030245733	3.786161611
GAPDHS	0.004878592	3.785630921
KCNK4	0.024660614	3.784846662
AMER3	0.006828133	3.783424063
PROZ	0.025233043	3.781528082
FAM71E2	0.037926514	3.779355496
OR10H1	0.033931873	3.777998285
DDN	0.021160237	3.775379509
FOXD4L5	0.007390988	3.775183613
F2RL1	0.010548865	3.774714268
ADCYAP1	0.020008885	3.774606472
ERVFRD-1	0.007563643	3.77427168
CYP2F1	0.023654834	3.773573754
ADGRG7	0.041514203	3.772787013
CAPN13	0.02067602	3.770815436
DCSTAMP	0.017743281	3.766545801
DMRTC2	0.013181727	3.765129543
RGL4	0.018887147	3.764760525
ZG16	0.007731525	3.760427509
NME8	0.023654834	3.75228485
IL36RN	0.038639049	3.751693879
SDK1	0.007015539	3.751638491
MYOZ1	0.013224289	3.751107672
PLA2G4F	0.007020871	3.751084672
KCNH6	0.007524436	3.750430729
OTOA	0.002484045	3.750198256
CRYM	0.0074605	3.747768677
CHST13	0.009277581	3.747017326
IL7	0.005352304	3.746140976
ACSBG2	0.021294454	3.744564073
C2orf54	0.004807471	3.743832067
KIF17	0.011137621	3.743381868
CCR3	0.016673729	3.739107507
TTC9B	0.015146712	3.738231105
GABRR3	0.020366334	3.736117498

PLAU	0.029386385	3.734961435
OTOP1	0.02633858	3.734778964
LHX3	0.039044607	3.73349357
EDAR	0.010635331	3.733345385
MUC22	0.034374305	3.733332781
PDE6G	0.014169206	3.732535775
SLC23A1	0.017240624	3.731473392
NTM	0.024660614	3.729843092
NXPH1	0.040265619	3.729563461
SMYD1	0.049172728	3.728345422
ASB5	0.028116131	3.727363518
KCNC1	0.020259258	3.722893977
PPFIA3	0.02478851	3.720993011
MZB1	0.00188708	3.720885177
SHISA8	0.036335446	3.720632425
COL20A1	0.014169206	3.720611569
CCDC42	0.018978261	3.720477141
COL6A6	0.011374687	3.718674151
OR51E1	0.028950403	3.715622005
NKX1-2	0.040322457	3.715291582
SMIM24	0.013035929	3.715159818
KCNIP1	0.040603299	3.714627988
APOA5	0.017271026	3.713560011
MOV10L1	0.005065007	3.71179277
SLC27A6	0.018458628	3.711239194
RBBP8NL	0.023039462	3.708907754
NLRP8	0.004118308	3.708517921
IL18RAP	0.023888134	3.708131403
MMP10	0.020150062	3.705026211
HRNR	0.021737482	3.702510808
CLCN1	0.028950403	3.702465342
SPTBN2	0.003854151	3.701347317
CYP2A6	0.020039652	3.700743383
CA12	0.03665743	3.700353327
HRH2	0.017777135	3.697089108
TTC29	0.044415122	3.69569138

RAC2	0.044601823	3.693523381
LY6D	0.023888134	3.692976865
GRM4	0.005149337	3.69291177
SERPINA12	0.011600762	3.692786359
METTL7B	0.021795612	3.692179252
AIM1L	0.029386385	3.691973272
ACOX2	0.019674716	3.689550622
SLC6A13	0.048592903	3.688365162
KIF4B	0.02125765	3.687199803
SH2D7	0.042242691	3.687145137
PRSS3	0.033797202	3.686653967
ZSCAN31	0.044236962	3.684436871
CALB2	0.008094122	3.68344178
C5orf47	0.025255778	3.677561425
KCNB2	0.023643695	3.676208794
DCAF4L1	0.010769424	3.672462575
CLEC2L	0.027223102	3.671549736
TREH	0.02070268	3.669435825
FCGR1B	0.017669286	3.6692739
CYP26A1	0.026453177	3.668417644
SLC22A7	0.011627286	3.66788005
INHBE	0.019748986	3.665623276
UBL4B	0.026054269	3.6653662
SYCE1	0.017395846	3.664838573
ATOH1	0.016683109	3.663724414
RTN4R	0.044244853	3.66257261
ago-99	0.015601712	3.659315068
PLCH2	0.035910094	3.659286295
IFNL2	0.040458418	3.659120435
ST8SIA2	0.045252388	3.657363337
OR1S2	0.017334245	3.656687857
HOXC13	0.034557873	3.655746521
CPA1	0.045659765	3.654147904
FUT7	0.020838188	3.653555235
SLC18A3	0.030297796	3.65302593
RFPL2	0.036586687	3.651642829

CCDC185	0.024852278	3.650804062
FABP6	0.007574062	3.649443909
RIIAD1	0.024522563	3.649267983
F12	0.028784233	3.648490084
ADGRA2	0.009696061	3.645008593
FAM64A	0.029348931	3.64335951
SLC6A17	0.005325595	3.641820101
MIP	0.021773674	3.640640893
OVOL2	0.045694489	3.639476107
DNAJC5B	0.011374687	3.638913332
KRT31	0.017743281	3.638122189
PROM1	0.02259052	3.634563679
TSPAN16	0.010635331	3.632358085
TMEM37	0.011586793	3.632179574
ANK1	0.001348285	3.630872858
BLACE	0.007862394	3.626596606
ZSCAN1	0.032467433	3.624948789
TRIM63	0.017743281	3.624891826
SLC25A41	0.006828133	3.62375552
DPP10	0.009923689	3.622523836
CAMK4	0.008880654	3.622051095
VSTM5	0.024252543	3.620337697
CCT8L2	0.03308342	3.618093526
MARCH11	0.013763511	3.617447356
KSR2	0.00261761	3.61679908
BASP1	0.038728497	3.614942266
RNF224	0.043305983	3.614777102
CD7	0.022365925	3.61307548
GGTLC1	0.042108084	3.611075207
RHOV	0.0365059	3.610515655
OBP2B	0.028386083	3.608746733
SNX31	0.030436004	3.608018319
C16orf78	0.031977215	3.607240395
TFF3	0.01404091	3.605941272
LCN1	0.028386083	3.60537755
SLC47A2	0.007879215	3.605289243

PCDHA7	0.03352273	3.604833108
SLC30A8	0.021562511	3.60337564
CFAP77	0.025300886	3.603138735
IL17B	0.031045213	3.600892035
EPO	0.012472186	3.600363854
HSD3B2	0.044145576	3.600100469
CD33	0.048783907	3.596541653
CST9	0.015199615	3.596234456
DRGX	0.030213196	3.592220011
ADRA1D	0.036130832	3.591677924
OLFML1	0.045267478	3.591210445
GATA4	0.027055697	3.59107102
ANGPT1	0.013252925	3.589242917
NIPAL4	0.018690312	3.587876119
DPPA2	0.014169206	3.586143561
TBX1	0.01497845	3.585937312
TBX21	0.033927091	3.583489284
GAL	0.023001749	3.583001078
GPR42	0.02645786	3.581694489
GRIK3	0.023380108	3.581410058
CHRM1	0.022004084	3.580684488
BST2	0.020102356	3.579637704
GAD1	0.041179394	3.578033545
CD300C	0.044887925	3.577900036
OIT3	0.015755648	3.577433147
GSX1	0.022365925	3.57699636
PRDM9	0.033641283	3.576964869
CRHBP	0.01409258	3.576707825
REG1B	0.025844217	3.576133425
FOXA1	0.038305007	3.567881015
TSGA10IP	0.021443248	3.56593432
DRD3	0.021427527	3.565525553
IFIT1B	0.02478851	3.561714933
SVOP	0.003970356	3.561519165
SLC1A2	0.001270518	3.560134734
BIN2	0.021737482	3.560106268

CST1	0.028950403	3.558208347
AQP8	0.025213475	3.55480849
MKRN2OS	0.012532328	3.554580723
SYT1	0.020771543	3.554342815
NR1I2	0.013880635	3.554299504
RASSF9	0.015601712	3.551851568
AGXT2	0.031597682	3.551155743
ALOX5AP	0.020039652	3.549058104
ARHGEF15	0.023040112	3.547507639
ABCB1	0.0384907	3.546503149
TRIML1	0.030143422	3.545208234
CEACAM18	0.012170459	3.542291758
PABPC3	0.034117483	3.542211392
SPATC1	0.012011123	3.541910578
SCN2A	0.023447174	3.540122891
RP11-468E2.2	0.045814496	3.536601826
SUSD4	0.035991138	3.535896449
ABCA13	0.006681182	3.535602016
PRSS55	0.009561345	3.534812715
ALOX5	0.030173988	3.534107364
EDNRB	0.018709222	3.53368111
FBXO43	0.016377123	3.533599999
TMPRSS2	0.015024385	3.532071043
CACNA1D	0.042412359	3.532014433
SLC28A1	0.012170459	3.531952138
DOK2	0.049597571	3.531782812
TMEM176B	0.016012138	3.531533555
MT3	0.025484503	3.529706122
CLEC4M	0.005687287	3.529165038
SLC22A14	0.020822913	3.529061133
TENM4	0.012358595	3.528942449
RBPJL	0.04632898	3.528188201
CLEC5A	0.017495079	3.526575006
FRG2C	0.02494248	3.525317594
CYP26C1	0.014123957	3.525195382
NME9	0.014270759	3.525151075

CLEC4F	0.017538633	3.52474436
ERICH6B	0.031319303	3.522442099
EN1	0.006875803	3.521757108
LHX1	0.018195739	3.521734531
ERICH5	0.032120977	3.520876889
VRTN	0.015926238	3.52009305
QRFP	0.028386083	3.518924836
FAM216B	0.023901186	3.518643169
TRPM5	0.035119796	3.517288569
CPVL	0.030436004	3.51661862
TDRD10	0.017560102	3.516178703
ASAH1	0.026199883	3.512685344
COL26A1	0.008695752	3.511649451
CSF3	0.035588166	3.510759934
CXADR	0.023665373	3.510293841
CBLN1	0.014438821	3.50651914
PIWIL3	0.011505598	3.504266954
CYP3A7	0.042718539	3.503932991
KLK12	0.033052661	3.503057042
HCN1	0.004807471	3.503055807
SPERT	0.030213196	3.498261579
HCRTR1	0.045800126	3.497656506
PSG1	0.027130503	3.494735428
PCDHA2	0.04048315	3.492880764
TRIM50	0.031191399	3.491027709
TMEM132B	0.002474449	3.486575601
SLC46A2	0.03352273	3.485424711
TJP3	0.028732398	3.484622871
PLA2G12B	0.028230045	3.483002459
GJD2	0.014169206	3.481333636
GPR6	0.035299897	3.479987315
GPR32	0.017691706	3.479181202
GRIN2B	0.004569339	3.478628878
CRH	0.027066943	3.476699567
GBX2	0.029920968	3.475550033
SYNGR3	0.02936103	3.475204359

GCGR	0.038292773	3.469052124
TREML4	0.044145576	3.468467168
CAP2	0.037611537	3.467114506
KCNQ4	0.008084861	3.466801652
MAEL	0.006071521	3.466361697
TREML1	0.045815396	3.463021407
APOA1	0.030810735	3.460654827
LRFN2	0.024307485	3.46051179
CD1E	0.031510463	3.458613603
FHAD1	0.007524436	3.458547858
TTK	0.005715706	3.457369488
CBLN4	0.029814856	3.45709304
TMCO5A	0.025887701	3.45663768
TCERG1L	0.017669286	3.456071859
PSG8	0.035816889	3.455436077
HEATR9	0.043122736	3.454646173
ENPP3	0.004008189	3.454032861
BLK	0.008242932	3.453189835
TCL1B	0.023039462	3.452670435
C1orf127	0.002918453	3.450540687
GBX1	0.037149597	3.448200767
OR7G3	0.016012138	3.444960467
FFAR1	0.044390768	3.444704993
KRTAP13-2	0.024092067	3.444219476
BMP7	0.047954934	3.443590808
GAD2	0.010717058	3.440007342
ARL5C	0.038082432	3.428047131
ISL2	0.02472886	3.421193319
MYO1H	0.035536041	3.420538391
SHANK3	0.031771259	3.420218505
PGLYRP3	0.023901186	3.419917475
DAO	0.012170459	3.417271835
ALX4	0.048250332	3.411923696
NTF4	0.02447727	3.409956231
ARID3C	0.018690312	3.409943246
KLHDC8A	0.03661455	3.407273883

GPR176	0.039785237	3.407028335
LRRRC72	0.031444423	3.406024037
HNF1B	0.005153697	3.405816629
CLDN1	0.049568011	3.403955978
LGALS7B	0.032243664	3.403307925
ENTPD8	0.02888788	3.402667107
SLIT1	0.021079584	3.401080986
IGFBP1	0.027088891	3.398628393
GFRA3	0.021497054	3.395985792
GPR62	0.046291896	3.394926555
RP11-310N16.1	0.026368379	3.39467539
RP3-382I10.7	0.036248749	3.393417462
VNN2	0.029386385	3.392243157
DOK3	0.023001749	3.391584785
TAL1	0.00379268	3.391275585
OPN1SW	0.032729742	3.388793718
RP11-240B13.2	0.01409258	3.385730729
PRDM1	0.029536654	3.384596893
TRPV5	0.01497845	3.381522566
LBX1	0.048336748	3.378563198
KANK4	0.035067872	3.377385907
CCDC105	0.035866349	3.376537257
ABCG5	0.017446366	3.375536714
MUC21	0.012205173	3.3747094
FNDC7	0.042242691	3.372694706
MS4A5	0.01730139	3.371887164
LRRRC32	0.048862168	3.370485367
CDKL4	0.038325009	3.369768682
ASB2	0.019210754	3.366300924
IRGC	0.022624407	3.365573689
NCAPG	0.038317656	3.363455518
KCTD16	0.035816889	3.362044408
ACTL7A	0.033927091	3.361376968
SLC5A1	0.016683109	3.361300777
OAS2	0.028641715	3.359691771
CABP7	0.042879475	3.357998778

KLHDC7B	0.019674716	3.356225358
OVCH2	0.015959206	3.352683439
ACSL6	0.004807471	3.351411542
PGA3	0.010044099	3.349202063
KCNN1	0.018064752	3.34560706
CABP5	0.019714174	3.344102619
SPATA31A7	0.028950403	3.341946009
PLPPR4	0.036855699	3.341534504
PCDHAC1	0.040074187	3.341525242
NKD2	0.028088316	3.341469056
ABCC11	0.024356252	3.340661552
INSC	0.028039762	3.338726594
TMEM190	0.016883312	3.337414865
ADCY10	0.039972585	3.334769184
ST8SIA6	0.01392699	3.33467108
TMEM132A	0.019611972	3.334108536
TMEM179	0.025501225	3.331876342
CYP17A1	0.030380343	3.33180138
ITIH1	0.027123607	3.330400617
TUBA3D	0.046698827	3.329123176
ADAMTSL1	0.030482698	3.328352436
TLL2	0.030555223	3.328077176
NEUROD2	0.008417687	3.327099212
SLC12A3	0.035738373	3.326787989
HOXB9	0.025503191	3.325519836
FBLN2	0.019482695	3.325002808
GFRA2	0.02792432	3.324917049
ASCL4	0.030915041	3.322334589
PLVAP	0.030067242	3.319542635
KCNJ11	0.003438278	3.319115538
KRT82	0.044887925	3.315220049
CNGA3	0.030029472	3.312929471
MIXL1	0.017334245	3.311947472
HEPACAM2	0.035129323	3.310534491
GPR17	0.039007312	3.309859125
ADAM21	0.018518091	3.309514009

CD1B	0.030968167	3.309373905
ACTN2	0.04069104	3.304803602
CDHR2	0.018690312	3.30419675
CHRM2	0.036855699	3.303983636
KLF17	0.028950403	3.302460062
DUOXA2	0.041514038	3.299523194
CTNNA2	0.017169948	3.297265317
LHX2	0.025440787	3.296843067
NR2F1	0.031019531	3.296519026
GDF2	0.015926238	3.29633663
DHRS9	0.02684106	3.294743504
TRIM17	0.034442357	3.293985484
PRSS38	0.023888134	3.293788984
PRSS22	0.021946129	3.292833534
C6orf223	0.030067242	3.291250582
NKX2-4	0.047690928	3.289924166
NEFH	0.01664201	3.28745203
SLC34A3	0.01978334	3.286823769
BPIFA3	0.045943949	3.284718713
OR4F17	0.030841985	3.284271909
PLA2G4E	0.032120977	3.283157919
AQP5	0.033606711	3.278447725
ADORA3	0.036920884	3.276492636
PLEKHG6	0.025213475	3.2754526
CCNA1	0.041826871	3.274455384
TRIM60	0.042718539	3.271567741
ASCL5	0.040778978	3.269466727
RHBDL3	0.009682947	3.266878732
GJA4	0.01392699	3.266807112
PADI2	0.006402439	3.263081735
RIMS4	0.036909774	3.262619335
OR2T33	0.047832747	3.261204078
SIRPG	0.030720511	3.260663537
MESP1	0.032261573	3.26058168
DDI1	0.038188232	3.259334203
PGA5	0.043493336	3.256137519

CYP2W1	0.023297553	3.25528205
DOCK3	0.034374305	3.254413477
TMEM150B	0.036002028	3.253779603
ANO5	0.020270242	3.253214821
OFCC1	0.035758388	3.251676507
CLIC5	0.04741087	3.249075416
IL4I1	0.028950403	3.246035887
PAX1	0.025255778	3.243548765
SULT2B1	0.020270242	3.242584212
ELFN2	0.041224353	3.242455347
ESM1	0.017560102	3.240115723
ALKAL1	0.031691627	3.238411978
AOAH	0.047954934	3.235512796
REG3A	0.045454203	3.231808117
SSTR1	0.041022259	3.230798352
TSSK1B	0.033510554	3.227822229
GALNT16	0.020428283	3.226136279
TMEM151A	0.031253816	3.225474746
NFAM1	0.010444838	3.225058284
LDB2	0.023001749	3.223743133
COX7B2	0.037392526	3.223030018
RUNDC3A	0.005795274	3.222323265
SEC14L3	0.025995261	3.221896229
APOC3	0.04334556	3.21988126
OTX1	0.020411851	3.219706918
SIGLEC8	0.004118308	3.219065847
KCNA4	0.022584239	3.217850434
KLK7	0.018804065	3.212419541
CASQ1	0.022018458	3.210095461
ADARB2	0.015785532	3.210083659
DPF1	0.019587427	3.208197011
EPHX3	0.035299897	3.206889723
CFAP99	0.049568011	3.20574611
IGFL3	0.022637476	3.203254723
TESC	0.03005113	3.202285432
SCN4A	0.026210433	3.200616755

FREM2	0.00761049	3.198928225
KRT33A	0.031143416	3.195895822
OTOGL	0.02684106	3.194209881
SOX30	0.042168635	3.193060101
FAR2	0.012130037	3.191801114
GPHA2	0.034840992	3.191526434
CLLU1	0.004118308	3.19029419
CACNA1I	0.016883312	3.189747202
HCAR2	0.041549007	3.189703002
PTPRB	0.005006158	3.187871273
CLVS1	0.019814939	3.183435112
ISM2	0.036899091	3.183027037
SLC12A5	0.019482695	3.182161014
A1CF	0.01392699	3.178369585
NR2E3	0.04491263	3.177250736
DNAH3	0.00917143	3.176168382
SOX10	0.045422837	3.174687635
NFE2	0.029386385	3.173190494
ADM2	0.014350283	3.16978189
AMBP	0.043523224	3.169284492
PRAMEF14	0.041835832	3.167067101
OPRK1	0.011726053	3.166712541
SLC35G6	0.049448588	3.166163704
FAT2	0.044145576	3.1530518
FKBP6	0.044359272	3.151227686
TDRD12	0.006681182	3.148813149
LRP2	0.003602047	3.147529929
LEP	0.029029339	3.147377348
SIGLECL1	0.040022772	3.147174001
OR2H1	0.02936103	3.141018006
NMUR2	0.021946129	3.138073598
RP11-302B13.5	0.044864188	3.135456042
NRG1	0.04963581	3.13348431
BHMT	0.022086391	3.132331861
REG1A	0.028980549	3.131876769
PROX2	0.010855971	3.130954497

RYR1	0.047832747	3.129828774
BRSK2	0.020318868	3.129435973
ALPP	0.036808847	3.129377403
PIK3C2G	0.030287877	3.12866723
FLRT3	0.034219701	3.122416662
APOBEC3H	0.043933914	3.120833061
SLC16A12	0.030798612	3.119581452
OR2W3	0.034728496	3.118319833
C10orf55	0.022127505	3.116475889
ANGPT4	0.017560102	3.111476949
DNAH9	0.045454203	3.108579343
RALYL	0.027899788	3.10627532
C11orf86	0.014350283	3.103955505
FLT4	0.001886172	3.102361173
RTP5	0.024356252	3.099437088
MOG	0.047610335	3.096495138
HOXB7	0.034442357	3.093357282
TMPRSS3	0.027633653	3.092615179
TMC4	0.035540323	3.091608259
ATOH7	0.04069104	3.089733938
HMP19	0.045922714	3.085657032
MTUS2	0.042068373	3.085056732
C19orf84	0.02447727	3.084841306
CAPN14	0.023654834	3.083387077
ANTXRL	0.017831636	3.081640631
KRT37	0.024799771	3.081116685
CIT	0.004153743	3.080113359
FOXD4L4	0.048804102	3.079907115
CR1	0.003752596	3.075560657
FAM107A	0.014123957	3.075084177
SLC13A4	0.016012138	3.072042762
TAF1L	0.045252388	3.066869405
FAM110C	0.032568693	3.065426591
TVP23A	0.009251262	3.065071131
IZUMO1	0.010855971	3.063708929
LARGE2	0.036084921	3.060554236

LRIT1	0.033606711	3.058678442
NPY1R	0.031044765	3.057989853
PAX4	0.013349591	3.055753939
USP43	0.028281772	3.052286886
RP11-723O4.6	0.023451351	3.052004627
BCL2L10	0.029622322	3.046618693
SMPD3	0.01392699	3.044173115
C16orf92	0.04250031	3.040492746
OPRL1	0.04491263	3.04017403
SIGLEC1	0.033931873	3.035704151
FMN2	0.009931228	3.035592356
VSX1	0.011600762	3.031001227
SERPINB11	0.035433472	3.030914988
SLC35F1	0.015547548	3.029797825
SBK3	0.043939761	3.028570427
SYT2	0.047634111	3.027751457
LRRC55	0.017854929	3.023833985
NLRP10	0.036855699	3.020317319
MDGA2	0.012993435	3.019687689
DPP6	0.016156553	3.017648522
ADH6	0.04575936	3.015910556
TFAP2A	0.008157712	3.012653186
HES4	0.031597682	3.008010073
B3GAT1	0.001640384	3.007821562
PRR19	0.011681909	3.006842777
MS4A15	0.025832537	3.005773502
JAKMIP1	0.038325009	3.001935274
FAM13C	0.021737482	2.999087098
SNTG2	0.038628528	2.997339633
RNF165	0.002918453	2.995877335
CALCA	0.044420231	2.99560819
FLRT1	0.028116131	2.988959151
FLRT2	0.001229282	2.988452379
RAB6B	0.041179394	2.977776736
DACH1	0.039766799	2.970021089
RBFOX3	0.008665547	2.967087674

FGF5	0.007947817	2.964825407
CPNE5	0.02210483	2.963102897
DUSP13	0.03005113	2.960219404
TNFRSF8	0.017669286	2.959018917
APC2	0.003707836	2.958807618
SLC44A4	0.024307485	2.95869719
BRDT	0.014755352	2.958592088
OR10Q1	0.02966509	2.957878386
KRTAP16-1	0.027637421	2.957825665
ZNF423	0.036778085	2.953455609
SPINK13	0.036454051	2.953390699
FREM1	0.04383848	2.951636422
GFAP	0.020270242	2.951238917
FOXF2	0.040322457	2.947489466
SMPDL3B	0.030287877	2.942679001
ZNF285	0.00496523	2.938622607
KLHDC8B	0.031597682	2.937371648
NOD2	0.026976422	2.936908325
MYBPC3	0.048261977	2.936189853
RASAL1	0.012993435	2.934879997
CCR6	0.045418596	2.933806164
LCK	0.041075339	2.932386761
SLC15A2	0.041179394	2.929327568
TNFRSF19	0.010717058	2.929112962
EPPK1	0.036084921	2.927883346
OR1J4	0.030650677	2.92663159
SEC14L5	0.009220588	2.92516864
TNFRSF11A	0.031857245	2.925156699
BICDL1	0.011180668	2.924859638
SSPO	0.007951805	2.919533493
WDR38	0.033927091	2.919170568
MYH15	0.028116131	2.918730115
B3GALT5	0.044033429	2.917172009
NRXN3	0.033927091	2.913665391
NCAPH	0.047026873	2.913549547
FCRLB	0.045252388	2.912717173

AGXT	0.012211639	2.911126507
CNGB1	0.007524436	2.910882382
FOXI3	0.01392699	2.909623754
KRT39	0.048623898	2.90893561
CFAP52	0.049374944	2.908358426
ADD2	0.00261761	2.907722659
STAC	0.039964574	2.907160038
CACNA2D4	0.002974993	2.903980442
GABRB3	0.003268599	2.903643269
CD96	0.027028321	2.902448144
MISP	0.034728496	2.90202571
EPHA10	0.042726515	2.895962951
MKRN3	0.022021837	2.892465938
LPAR3	0.034169242	2.892392459
TP53TG3C	0.048594085	2.888415735
SLC36A3	0.038214248	2.88491462
TAS1R1	0.036909774	2.882897154
MLXIPL	0.017777135	2.879880179
GABBR2	0.014123957	2.878170243
FUT2	0.005136025	2.877933919
UNC13C	0.003752596	2.876926659
COLCA2	0.028980549	2.87532052
MRGPRX3	0.018472891	2.873554324
ALG1L	0.040536958	2.871975495
TMEM233	0.024307485	2.870598589
GABRG3	0.004233231	2.866180107
SLC4A8	0.002493786	2.864672035
GF11B	0.035816889	2.862501073
KLK10	0.01664201	2.855706698
IQGAP2	0.03352273	2.855360717
CYP2B6	0.013724229	2.854922804
IGSF11	0.029489839	2.853941561
LRRC4C	0.028995898	2.85308439
ST6GALNAC1	0.039175634	2.852293412
PRRG2	0.038840329	2.850222138
MUC4	0.02936103	2.845306056

CLSPN	0.023052407	2.842790504
TISP43	0.018709222	2.840309823
NETO2	0.031218055	2.839204667
DMTN	0.013763511	2.838590799
H1FOO	0.041915811	2.834515035
IL17RD	0.035866349	2.834180808
PRR26	0.041266332	2.828018912
CELF4	0.002518505	2.825503963
SNPH	0.044313645	2.82541882
PTPRH	0.042855987	2.820851821
VWA5B1	0.005345186	2.81918892
AFAP1L1	0.011213295	2.818353715
OSR1	0.04034072	2.816552204
CYP4A22	0.045454203	2.812292269
CCDC155	0.009614159	2.80888204
TMEM56	0.005354413	2.808565441
FBXL22	0.02938624	2.80772283
TMEM150C	0.026976422	2.807623482
STAR	0.028002186	2.80218387
CYTH4	0.02082091	2.80069681
FLG2	0.013582951	2.797530919
PRB3	0.034283341	2.796817661
SLAMF7	0.009220588	2.79515542
AP000304.12	0.029348931	2.794903439
AADA4L4	0.047491095	2.794138845
SULT1E1	0.012472186	2.790975343
GP2	0.021972238	2.790966171
NID2	0.03801036	2.790958336
FSTL4	0.002534226	2.784356394
ATP1A3	0.023447174	2.783956212
CHODL	0.031597682	2.783346003
CNTNAP5	0.047609162	2.779308017
PABPC4L	0.020822913	2.778196148
CALB1	0.005511987	2.776067472
KLK8	0.034631683	2.76700095
C15orf59	0.026560687	2.766695329

STMN4	0.023001749	2.764094831
TRPV6	0.027088891	2.762106804
SLC51B	0.042260344	2.760818821
SCN2B	0.006217257	2.758904964
CPLX4	0.034373095	2.758728911
ADAD2	0.028950403	2.757093286
CLDN17	0.036325771	2.75112839
HNF4A	0.017169948	2.750445864
GDNF	0.042108084	2.748766007
PRR11	0.022584239	2.747845936
NCALD	0.006077388	2.742840891
MAP6D1	0.029066912	2.74000098
TRPM8	0.013252925	2.738112769
SLC5A10	0.023937329	2.727843569
SIX3	0.012352622	2.727689944
PLXNC1	0.021408786	2.722847269
RP1L1	0.002526985	2.72096688
WFDC12	0.036325771	2.715509934
DBNDD1	0.016232331	2.714763391
CDT1	0.024404879	2.714341802
CA6	0.010635331	2.714088769
FAM181B	0.014270759	2.711506808
CD300LG	0.046175271	2.709673281
PNPLA1	0.035262358	2.709492358
CRYBB3	0.044390768	2.707141118
UPB1	0.036084921	2.705438119
ANKRD62	0.027153062	2.701140444
PPP2R2C	0.02684106	2.699978123
SPINK1	0.017945204	2.69638333
MGAT5B	0.039785237	2.690611076
PKP2	0.007466915	2.687068659
SMIM22	0.048142441	2.68640981
MYCT1	0.041773281	2.684456644
FAM110D	0.005505196	2.682707086
ZNF391	0.026278002	2.681919633
NUDT14	0.036373794	2.681687866

MRVI1	0.023888134	2.681633438
MCAM	0.018356973	2.677540974
HIPK4	0.03308342	2.672157469
MAST1	0.030380343	2.669027365
HPDL	0.034219701	2.664781961
PCDH15	0.047703715	2.661747847
FILIP1L	0.02633858	2.657953345
GOLGA6A	0.013763511	2.656507216
BICDL2	0.037578705	2.655107836
TRIP13	0.023824881	2.64732505
GREB1	0.003926623	2.646795432
ADH1B	0.037733681	2.643586681
CCDC172	0.038656204	2.640019035
NCF1	0.019436198	2.639326457
HP	0.027969728	2.631963414
CDH22	0.020270242	2.630127732
PRR23C	0.018543341	2.629374088
CACNA1E	0.021050675	2.627892355
TSPAN19	0.019442588	2.619057528
HEY1	0.042582273	2.618395479
TRIM40	0.039964574	2.616728189
FGD2	0.008499347	2.615228194
PKHD1	0.025233043	2.613643178
PRR27	0.048623898	2.61168779
SLC22A2	0.016233198	2.610218431
NOS1	0.004807471	2.607265498
NLRP3	0.003911557	2.607192546
TMPRSS13	0.035377999	2.606507952
FCAR	0.034442357	2.599894912
IL15	0.006895293	2.597958909
C17orf99	0.028589285	2.596278833
PM20D1	0.030029472	2.595934261
ADAM19	0.047157333	2.591444523
CCDC153	0.019482695	2.587848338
AMT	0.043282116	2.587289386
WWC1	0.01392699	2.58641081

MMP16	0.044448914	2.585966272
CPA4	0.035119796	2.58340627
DNAH2	0.01404091	2.580534214
CELSR2	0.044566254	2.579310477
SSUH2	0.008615202	2.576225597
NAPSA	0.046193465	2.571400931
TMEM52B	0.022750233	2.5687225
PKDREJ	0.043101042	2.559283978
LIX1	0.025832537	2.558697277
PNPLA5	0.049737588	2.555569848
PDE6B	0.038786914	2.55196002
MMP25	0.011469395	2.549074503
FMO3	0.046056202	2.547544313
SNTG1	0.025575768	2.54679217
CLSTN2	0.033829931	2.545014083
ASIC1	0.029665073	2.543424243
IL10	0.032915037	2.540390402
MDS2	0.011889341	2.538448111
INSL6	0.003926623	2.518492973
OPRD1	0.006389619	2.51408658
ACER1	0.036985379	2.51038499
TBXAS1	0.023001749	2.50187761
IGF2BP3	0.011726053	2.498390438
ANXA8L1	0.011137621	2.495548691
NRXN1	0.015926238	2.48776472
TMEM171	0.049051866	2.485135872
C2orf83	0.017395846	2.484522052
TNNT1	0.019835947	2.478165298
ADCY4	0.017597891	2.476500269
SPTB	0.030676254	2.474573428
MARCH1	0.034561004	2.474316701
CEACAM8	0.033927091	2.473923279
ADAMTS2	0.012018138	2.472829284
ELFN1	0.040337886	2.472168203
SLC30A3	0.013284097	2.466887268
RASSF6	0.038881876	2.465184777

JAKMIP2	0.034513072	2.464845644
BTNL9	0.016125184	2.461677117
LRRC36	0.031989532	2.457500509
SLC35F4	0.043458667	2.449394663
ZFR2	0.038378347	2.428871798
RDH16	0.005006158	2.426676828
IRGM	0.025143726	2.424023725
PTK6	0.019998588	2.423397104
SLC29A4	0.002493786	2.415571656
DPF3	0.039785237	2.414101357
ANXA3	0.024434395	2.410571141
ARNT2	0.028230045	2.409197576
ACVRL1	0.046251894	2.402264944
RGS11	0.036920884	2.400753841
COX6B2	0.046035029	2.400677896
ST6GALNAC3	0.029752324	2.39376686
LCN12	0.040235333	2.393438383
DNASE1L3	0.021355725	2.390669392
BSND	0.031743774	2.382036728
KCNK10	0.028081249	2.376685002
TRIM71	0.030029472	2.361540374
DMGDH	0.032830904	2.36122717
AICDA	0.028116131	2.358921936
TRIM59	0.02938624	2.353119509
RGS9	0.035245459	2.347200959
NOX5	0.004079499	2.343682414
KCP	0.01598646	2.341468937
ABCC6	0.0363809	2.340821513
CDCP1	0.040473137	2.33940564
RBM20	0.036084921	2.336662263
SLC12A8	0.026384068	2.336084332
FAM78A	0.037926514	2.332027732
CD34	0.023092794	2.329088611
B3GNT4	0.047058018	2.31363091
SLFN12	0.049101584	2.310949717
TACR2	0.020048752	2.310167152

DAND5	0.028116131	2.310156767
OR51E2	0.038214248	2.306046679
SHISA9	0.004233231	2.302334566
ANKRD1	0.038237768	2.301023021
GGT6	0.035348445	2.299129544
SULT1B1	0.004487568	2.298851044
ZNF716	0.025947485	2.291809158
MYO1F	0.024964488	2.28975088
TIE1	0.032994665	2.284887271
SLC7A7	0.038188232	2.284222512
SCN9A	0.029348931	2.281819461
PRKCB	0.017743281	2.28124195
HAP1	0.017595421	2.279243035
CAPN8	0.035239643	2.277671651
NOTCH3	0.016883312	2.277563829
ILDR1	0.035540323	2.276007769
SYT5	0.036130832	2.274192433
MAP1LC3B2	0.03715314	2.272278452
ASTN2	0.005699402	2.268966339
GABRA2	0.043282116	2.267296057
IGF1	0.046441546	2.26613222
UTS2B	0.014169206	2.263800607
NCAM1	0.045454203	2.262990698
PRKG2	0.008417687	2.258927143
SLC22A25	0.008912632	2.258919788
KIR3DX1	0.04659258	2.255242547
DPYSL5	0.013476945	2.250432799
IL21R	0.011518961	2.246921915
NALCN	0.037835852	2.227970241
SHANK2	0.024092067	2.227933079
FAM3B	0.030245733	2.227638723
GRIA4	0.018961449	2.217114047
MEIOC	0.014169206	2.216842504
RACGAP1	0.044145576	2.216434247
PNMAL1	0.019482695	2.20916581
PTPRN2	0.035950483	2.202591267

PCSK2	0.020515054	2.196984799
CCDC3	0.039175634	2.194120126
ATP1A4	0.029489839	2.192162337
RNF32	0.035067872	2.184402991
RET	0.040572742	2.179702799
SLC5A5	0.022641444	2.171411671
NMNAT2	0.013069497	2.166787136
TCF23	0.024522563	2.166637822
C6orf141	0.043583087	2.166420612
GDPD1	0.02936103	2.153860804
MLANA	0.025213475	2.152145513
BNIP1	0.021737482	2.15058917
LDLRAD1	0.034373095	2.150051026
HSPB9	0.043113476	2.148492316
IGFL4	0.005593517	2.147908772
C4orf32	0.006760763	2.140641751
IRF6	0.03015884	2.14044814
PAQR5	0.031457537	2.136609182
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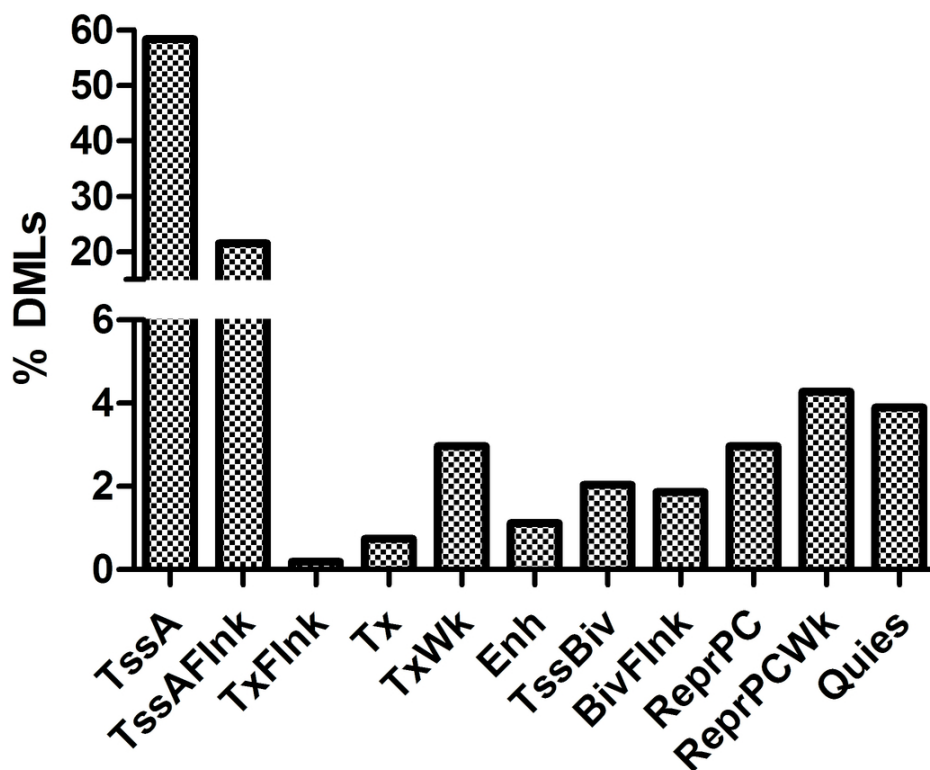
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TPH2	0.049530854	1.090040922
MATN2	0.043598127	1.067591714
RILPL2	0.042726515	1.066142298

mtDNA: mitochondrial DNA; logFc: log fold change; adj. p-value: adjusted p-values calculated by Benjamini & Hochberg's method for false discovery rate (FDR) control



Supplementary figure 1. Genomic location of DMLs between haplogroups H and J. Percentage of DMLs between haplogroups H and J on each of the genomic locations attending to the chromatin states described in the Roadmap Epigenomics Consortium. TssA: Active transcription start site; TssAFlnk: Transcription at gene 5' and 3'; TxFlnk: Strong transcription; TxWk: Weak transcription; Enh: Enhancers; TssBiv: Bivalent/Poised transcription start site; BivFlnk: Flanking bivalent Tss/Enh; ReprPC: Repressed PolyComb; ReprPCWk: Weak repressed PolyComb; Quies: Quiescent/low

94x80mm (300 x 300 DPI)