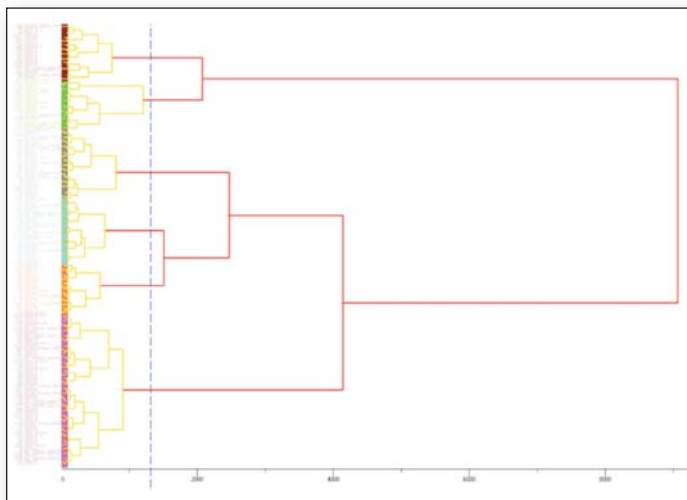


## Cluster Analysis

### Intelligent Instruction for Detailed Geometallurgical Analysis

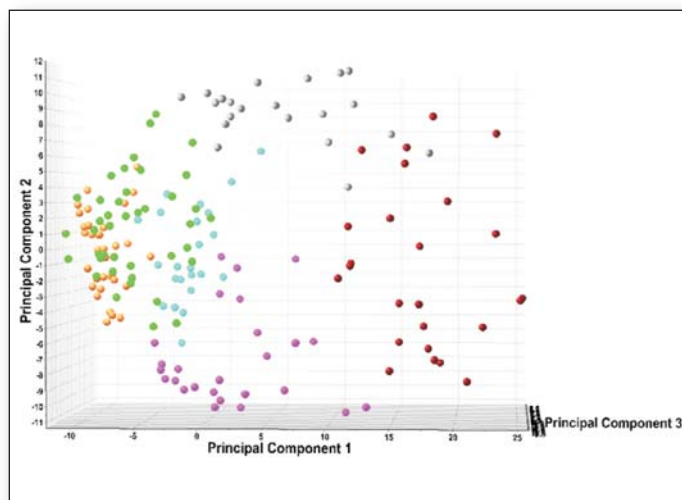
At Actlabs, the X'Pert HighScore Plus software is capable to perform cluster analysis on X-ray diffraction (XRD) patterns. This is a statistical tool that groups XRD patterns into clusters based on the similarity of their peak and profile information, and it can be used to rapidly group large data sets into smaller clusters with more similar mineralogy. Distance measures between samples and linkage methods between clusters in a data set are used to determine how the patterns are clustered, and a cut-off method is used to determine how many clusters are produced. This indicates the pattern within a cluster that is the most similar to all other patterns within the cluster, as well as two patterns within the cluster that are the least similar to all other patterns within the cluster.

DENDROGRAM



Different Mineralogical clusters, showing the most similar pattern.

PRINCIPLE COMPONENTS ANALYSIS (PCA) PLOT



PCA plot along 3 principle component axes, showing the distribution of samples in six clusters.

These results can be used as a basis for selection of samples for full mineral identification and quantification. Principle Components Analysis (PCA) can be used as a visualization tool, to illustrate how the clusters are organized in relation to their principal component axes. Principal components are linearly uncorrelated variables which account for as much of the variability in the data set as possible. Cluster analysis has

potential applications for mining and exploration, wherein clustering could highlight the changes in the mineralogy within a deposit. Clustering could also determine mineralogical variability within metallurgical process samples, which could then be used to monitor process methodology.