Application note on mineral phase analysis

elements	concentrations (%)
Al2O3	15.1
SiO2	61.1
P2O5	3.6
K2O	4.84
CaO	1.75
TiO2	0.12
V	0.004
MnO	0.27
Fe2O3	9.43
Ni	0.022
Zn	0.011
Ga	0.015
Rb	0.041
Sr	0.012
Y	0.19
Zr	1.21
Nb	0.053
Ce	0.14
Pr	0.05
Nd	0.084
Dy	0.084
Hf	0.047
Pb	0.024
Bi	0.0037

Table 1.

The data-set recorded from cores (Tasman metal) taken from the REE rich area at Norra Kärr, Sweden provides an excellent example of how the Itrax Drillcore scanner operates. The scanner does not just provides average concentrations for a large number of elements (see table 1.) over the core but it actually records the concentrations of elements from bulk down to trace amounts, at a large number of points over the entire core lengths. By displaying these analyses together, the concentration profiles over the core can be visualized as superimposed on top of the high resolution photo taken during the scan. The Itrax scanner can operate at a very high analytical speed of up to 1.600 000 cps, and can therefore spend as little as 1 second at each point. Due to the high speed recording of XRF data, large number of data points can be recorded with just a few minutes with good data quality. By using elemental correlation analysis, it is also possible to relate various elements to each other and thus identify mineral phases. On the next page is shown a core section photo together with analytical data for REEs.
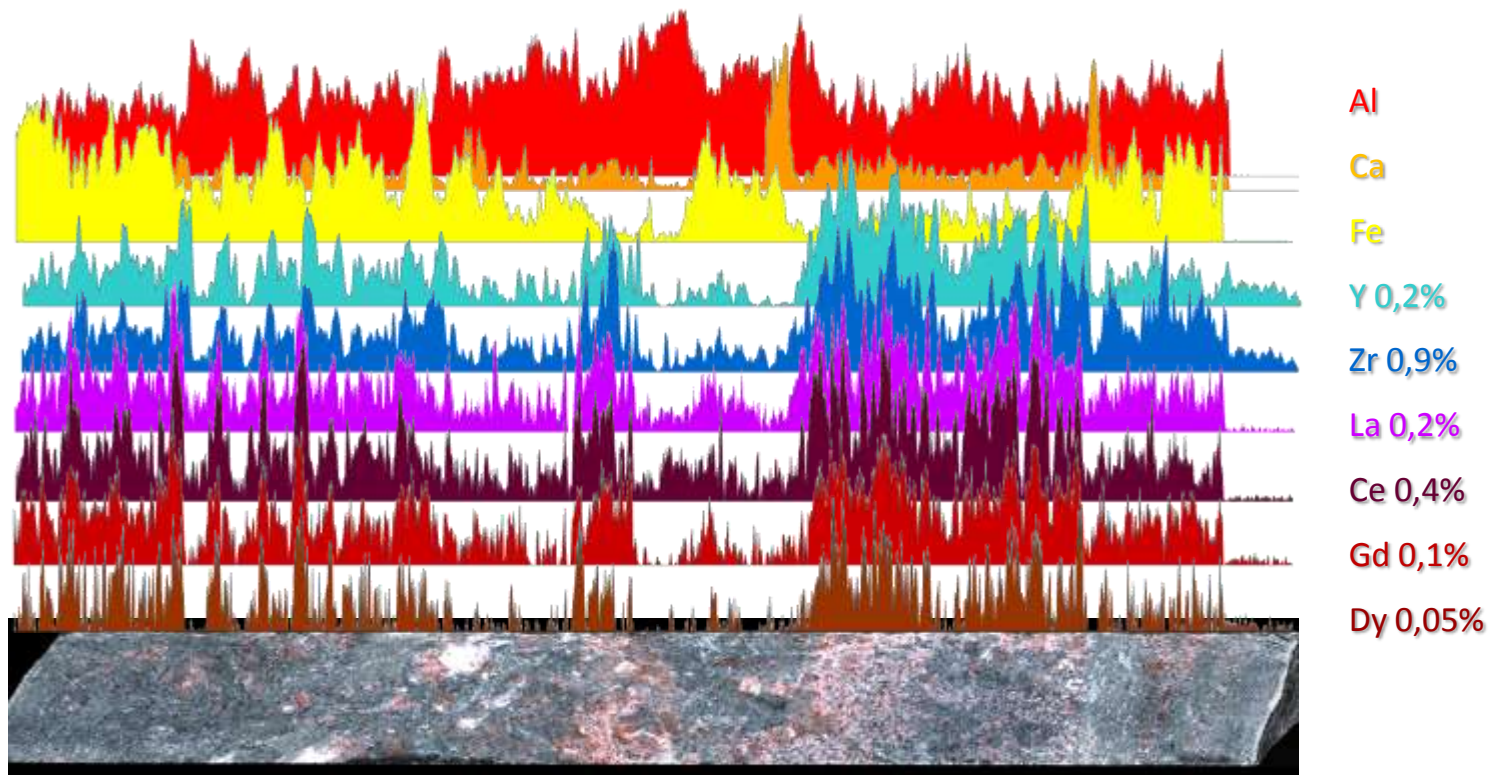
Al
Ca
Fe
Y 0,2%
Zr 0,9%
La 0,2%
Ce 0,4%
Gd 0,1%
Dy 0,05%

Fig 1. This photo shows a core section from the REE mineralization in Norra Kärr, Sweden. Above the photo are shown element profiles displayiong the distribution of each noted element along the core. The chemical symbols and the average concentration for each element is noted to the right of each profile. The sample was kindly provided by Magnus Leijd, Tasman Metals

As can be seen from the XRF spectrum in fig. 2, Yttrium (Y) appears as clearly visible x-ray lines, but a number of other REE are also recorded. Many of the REE lines can be heavily overlapped with lines relating to other elements and thus not easy to verify. However, the strong correlation between Y and all the other REE's recorded, i.e. Nb, Ce, Pr, Nd, and Dy indicates that these lines has been recorded properly and that all the REE's, as identified in the spectra, belong to the same mineral phase.

This phase also contains Mn and a strong component of Zr. However, the correlation diagram of Zr and Y (fig. 3) clearly shows that the Zr also appears in another phase, since there are ratios which fall over the "line". From that diagram one can conclude that the Zr/Y concentration ratio is close to 4, so the Zr concentration in this phase should be about 0.76% as compared to the total Zr concentration of 1.21% (see table 1). It has been assumed that the REE rich phase is Endialyt which according to Mineral data should contain 9% of Zr. This means that we can calculate that Endialyt appears in the core at an average concentration of 8.4% and the total amount of REE in the mineral is 7.1%. The MnO concentration in the mineral is 3.2% which makes sense to what is known about Endialyt in mineral data-bases. The 2nd Zr phase is assumed to be Catapleiite where Zr appears at a concentration of 22%.
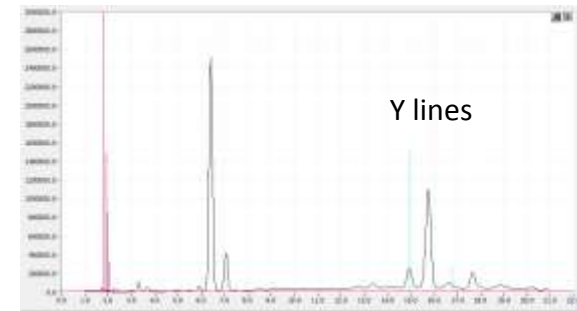

Y lines

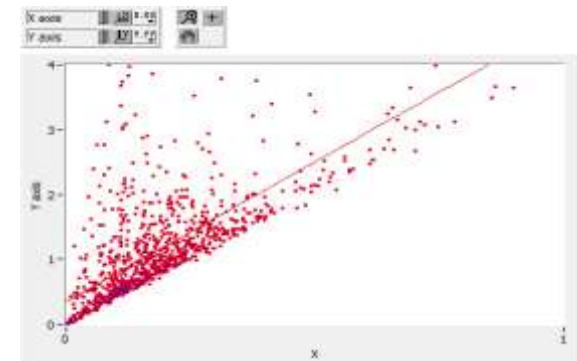Fig.2. Spectrum with Yttrium lines marked

Fig. 2. Zr - Y correlation

This means that the average concentration of Catapleiite in the core is about 2%. This type of phase identification and analysis is possible thanks to the way the Itrax scanner operate and the high speed performance of the scanner. The variation of Endialyt over the core can easily be visualized by just looking at the Y variation, as Y only appears in this phase The variation of Catapleiite is a bit more complicated as there is no element that appear solely in the mineral, however the co-variation of Y and Zr can used to establish the Catapleiite variation as well.

In this way, the Itrax scanner opens up new ways and perspectives on mineral analysis, where information of even minor mineral phases can be established, and trace amounts of elements can be validated within short time. Two good examples are the precise correlation between Y and Nd (fig. 4), and Zr and Hf (fig. 5) which demonstrate that even very small amounts of "odd" elements like Hf can be properly recorded at each measuring spot with just 1 second measuring time per point, and form a basis for analysis.
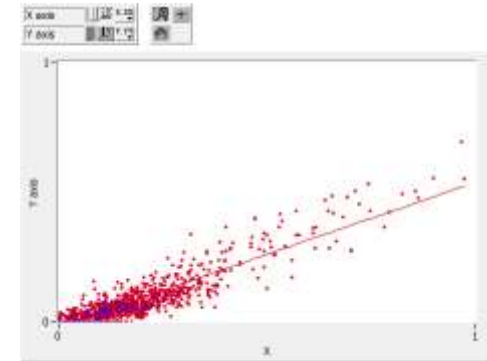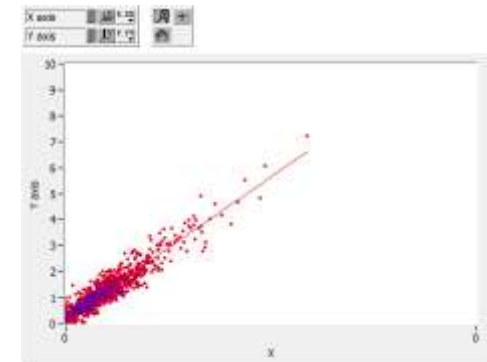

Fig. 4.Y – Nd correlation

Fig. 5. Zr – Hf correlation

The variation of Endialyt (green) and Catapleiite (red) along the core