

# SPECTRAL EVOLUTION

## Heavy Rare Earths (HREEs)

There are 17 rare earth elements in the periodic table and they are considered rare because they are not usually found in commercially viable concentrations. REE rich minerals are often byproducts of mining other mineral commodities. The rare earths are divided into light (LREE) and heavy (HREE) rare earths. HREEs include:

- ◆ Europium
- ◆ Gadolinium
- ◆ Terbium
- ◆ Dysprosium
- ◆ Holmium
- ◆ Erbium
- ◆ Thulium
- ◆ Ytterbium
- ◆ Lutetium
- ◆ Yttrium

HREEs are important for high tech and energy products: Dysprosium for permanent magnets, Europium for phosphors and fuel cells, Terbium for phosphors and permanent magnets, and Yttrium for red phosphor, fluorescent lamps, ceramics, and metal alloys.

Rare earth element bearing minerals can include oxides, carbonates, phosphates, and silicates. Most minerals in these groups contain LREEs. Typically HREEs have been found in smaller quantities in monazite, and in commercially minable quantities in xenotime. Xenotime and monazite are both phosphates.

Using a field spectrometer, like the SPECTRAL EVOLUTION oreXpert, oreXplorer or oreXpress, xenotime can be identified using *in situ* reflectance spectra. These spectrometers with EZ-ID mineral identification software can quickly and accurately identify xenotime by comparing target scans against the USGS and optional SpecMIN and GeoSPEC mineral spectral libraries which include known sample spectras of this mineral. In addition, EZ-ID includes custom library building capabilities so that using a known xenotime sample from the location can become a project xenotime library.

The oreXpert, oreXplorer and oreXpress are designed for field work. They're lightweight, sturdy, and reliable. They provide the highest resolution and sensitivity available in a field unit and are equipped with a comfortable handheld mineral contact probe and are available with a benchtop probe with a sample compactor.

EZ-ID allows you to select specific features within your scan for in-depth comparison and analysis. All spectra and associated data are saved in ASCII file format for use with popular 3rd party software packages, such as TSG. EZ-ID can be a valuable tool in finding mineral bearing HREEs, without destroying samples.

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*EZ-ID software provides mineral identification. Here is a sample of xenotime from the SpecMIN library.*



*This EZ-ID display shows a SpecMIN library sample of monazite which may also contain HREEs.*



*oreXpress in the field.*

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