

Advancements in Field Portable NIR Mineral Spectroscopy (2007-2017)



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History



- PIMA: Portable Infrared Mineral Analyzer



“The PIMA alone was a major factor in the development of infra-red spectroscopy as a field tool in mineral exploration...”

Agar and Colter, 2007

History



- ASD TerraSpec



ASD TerraSpec (circa 2004)

Improvements from PIMA

- Incorporated VNIR
- Faster collection times
- Better quality data

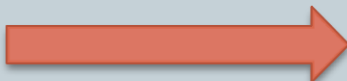
“...this instrument replace(d) the PIMA as the preferred field spectroscopy tool...”

Agar and Colter, 2007

Advancements/Developments



- Improved Spectral Quality/Collection Speed

TerraSpec  TerraSpec 4
SEI OreXpress

2017 instruments have 2.5x (or greater)
improvement in quality/speed

More accurate data, faster core logging

Advancements/Developments



- Spectral Evolutions (SEI) releases a dedicated mineralogy solution in 2011
 - Customer choice: competition is good for the customer
 - ✦ Portability
 - ✦ User experience
 - ✦ Accessories
 - ✦ Data quality
 - ✦ Price



Advancements/Developments



- **Portability**

- SEI has done a better job at making their main instrument line more field friendly. Better field design, lighter probes, hand held computers all make the OreXpress more field friendly than the TerraSpec4.



Pic: Courtesy SEI

Advancements/Developments

- **Portability**

- TerraSpec Halo

- Handheld form factor
- On-device mineral results
- Automated tools for ease of use
- Released in late 2013, it is now the dominant seller in the market.



Pic: 2014 Evolution Mining Annual Report

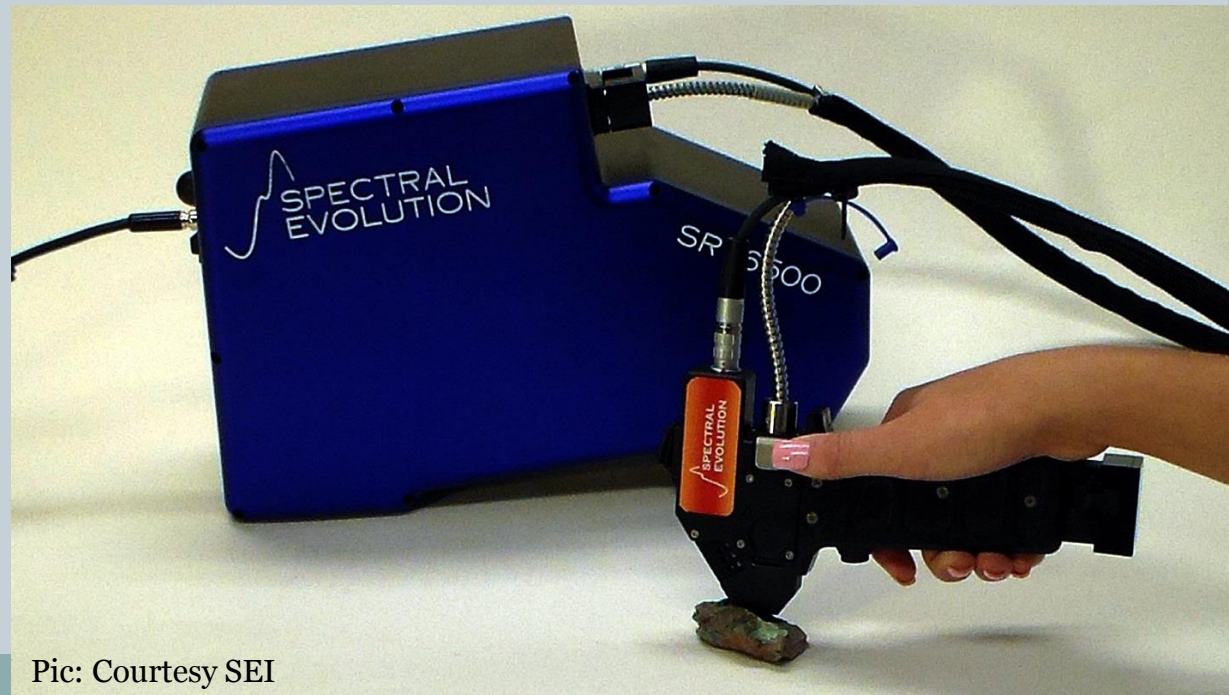
Advancements/Developments



- **SR-6500**
 - Ultra high resolution spectrometer with resolutions of 1.5 (700nm), 3.0 (1500nm) and 3.8 (2100nm)

Greater detail in spectra providing better delineation of mineral species or minerals in trace amounts.

Released in late 2016



Pic: Courtesy SEI

Advancements/Developments



Non-instrumentation developments

- Automated Spectral ID tools
 - 2007: TSG, SpecMin
 - 2017: TSG8, SpecMin/EZ-ID, aiSIRIS, Halo as well as CoreScan and TerraCore
- Spectral Analysis/Viewing Tools
- Connectivity/Software Integration

Field Investigations



- Mining recession affected adoption of recent portable NIR advancements.
 - TerraSpec Halo released late 2013/2014
- Post-recession increase in “Spectral as a Service”
- Two ‘models’ - both with goals of increasing efficiencies and minimizing costs

Field Investigations



- **Larger/Major organizations**
 - ◆ Large scale investigations or brownfields with multiple instruments
 - ◆ Larger organizations looking to standardize processes across locations
 - Easier operation allows for technician level use often times with remote oversight.
 - Easier group trainings particularly in areas where English is not spoken.
 - Halo error messaging allows for easy response

Field Investigations



- Juniors/Smaller Organizations

- ◆ Team-focused site approach



- Real time data modeling

- ✦ Teams using real-time data to address investigative issues
- ✦ Data updated daily onto field tablets for following day investigation; layered data
- ✦ When applicable, increased used of spectral scalars in real time
- ✦ Creates more thorough, cost-effective investigations

Mature Technology



- Spectral geology has become a mature technology.
 - Variety of instruments to choose from
 - ✦ Both ASD and SEI have multiple instrument options
 - Variety of interpretation software
 - Many visualization packages
- Education and awareness has continued to grow across the industry as value has become more understood.
- Need continued published research to shape the next decade of instrumentation