Material Characterization: Spectroscopic Methods

Customer Need

Conventional petrographic analysis yields valuable information about basic reservoir qualities, such as porosity and mineralogy, and relationships between the two. The addition of organic matter identification, fluid inclusion analysis, and a mineral map acquired by spectroscopic methods broadens the value of petrography.

Raman spectroscopy adds insight into the petrographic analysis by providing details on organic matter and mineral composition not available under a light microscope.

Instrument Setup

Figure 1: HORIBA LabRAM HR Raman Microscope and FTIR

Raman analysis is non-destructive and requires little to no sample prep. The Raman setup utilizes a confocal microscope able to image and analyze a ≈1µm spot. The setup allows analyses of samples ranging from thin section to core plug. Samples can be analyzed using both Raman and FTIR* at the same point on a flat surface.

The Linkham THMS600 heating/cooling cell is available to attach onto the large XYZ controlled stage. This allows for analysis of small samples at temperatures ranging from -196 to 600 °C. The microscope allows for viewing up to 50x while collecting Raman spectra during a heating/cooling cycle.

Applications

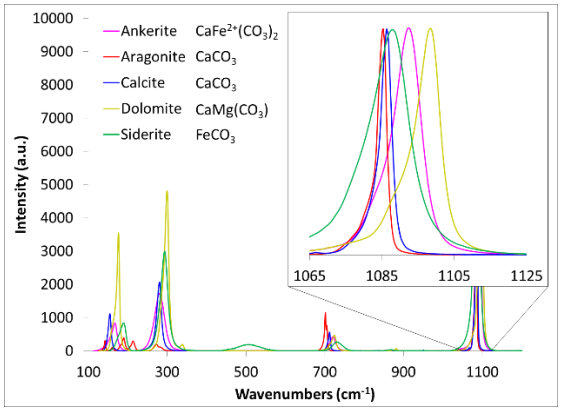

Figure 2: Variation in Raman peak positions allows us to differentiate between carbonate species.

Raman spectroscopy is not only able to differentiate between minerals of the same composition, but also between minerals of the same group. Small differences in peak position distinguish various carbonate minerals of similar compositions (Figure 2). The spectra are compared to several databases via spectral matching. The databases include in-house mineral specific and general materials. The in-house database includes many original Source Clay minerals in the Premier collection that improves the identification of clay minerals within a sample.

*Soon to be available

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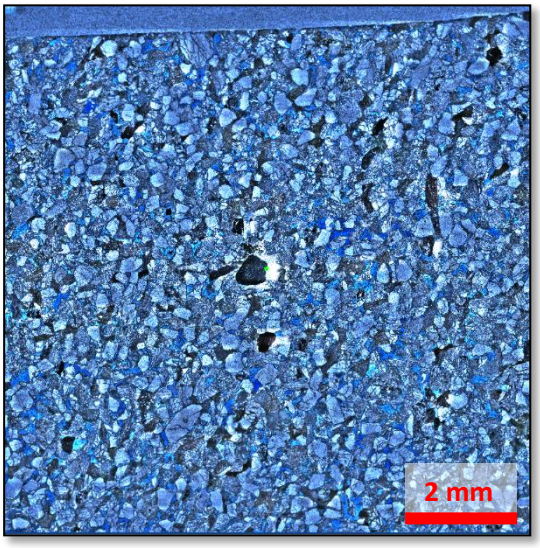

Figure 3: Reflected and transmitted light image of a sandstone thin section

A large field-of-view image is used to identify regions of interest for high-resolution imaging and mapping areas (Figure 3). Mineral maps can be generated for the region of interest at a range of spatial resolutions, down to several microns. Data processing allows us to generate images differentiating the chemically different phases present.

Figure 4 shows a mineral map of a sandstone thin section. In the processed image on the right, there is quartz, organic matter and clay present. Spectral analysis indicates that there are two different types of organic matter present in the sample. Raman spectroscopy is a useful tool to identify and give a general idea of the composition and maturity of the organic matter.

Raman spectroscopy analysis requires little sample prep and is a quick, nondestructive technique to identify unknown chemistries. It is also useful for differentiating types of organic matter.

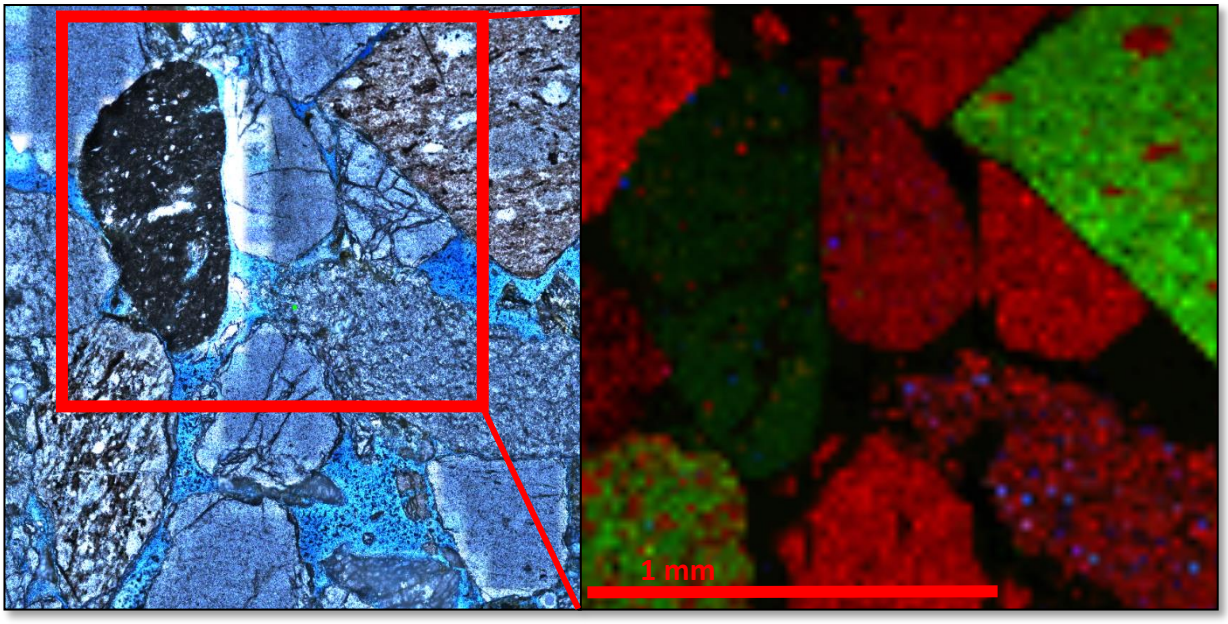

Figure 4: Mineral Map of a Sandstone: Red = Quartz, Green = Organic Matter, and Blue = Clay.