

Reflectance spectra of terrestrial barites conducted in the Planetary Emissivity Laboratory (PEL)

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1. Introduction

The most important source for barite on Earth is often associated to sedimentary exhalative sulfide deposits (SedEx) and volcanic environments generated by hydrothermal activity. BaSO_4 is also related to epithermal deposits in volcanic rocks and is a common gangue mineral in veins and fractures due to wall rock alteration [1]. Thus, these minerals often reflect close environmental compositions and are therefore interesting for the understanding of volcanogenic and hydrothermal activity on terrestrial planets.

In this study, we present our first results of selected samples from an ongoing spectral and geochemical investigation on barium sulfates (barite minerals, provided by Deutsche Baryt-Industry, Bad Lauterberg). We analyzed our samples with bi-directional reflectance measurements conducted in the Planetary Emissivity Laboratory (PEL) at the German Aerospace Center (DLR) in Berlin, Germany.

2. Reflectance set-up at PEL

The PEL is equipped with an evacuable Bruker Vertex 80V and an older Bruker IFS working under purging. The two instruments can work independently and in parallel, since they do not share any crucial device.

The new generation Bruker VERTEX 80V FTIR spectrometer has a very high spectral resolution (better than 0.2 cm^{-1}), and a resolving power of better than 300,000:1, and can be operated under vacuum conditions to remove atmospheric features from the spectra. To cover the 1 to $16 \mu\text{m}$ spectral range, a liquid nitrogen cooled MTC and a KBr beamsplitter are used.

The other instrument available in the laboratory is a Bruker IFS 88, purged with dry air to remove particulates, water vapor and CO_2 .

By means of the Bruker A513 accessory, and VERTEX 80V instrument, bi-directional reflectance of minerals, with variable incoming and outgoing angles (between 13° and 85°) are obtained. We can measure room temperature samples, under purged air or under vacuum conditions, covering the 1 to $16 \mu\text{m}$ (MIR) spectral range. Absolute reflectance is obtained when measuring a sample against a reference background that is a gold-sandpaper coated full cup in the case of MIR measurements.

Similarly, a Harrick SeagullTM variable angle reflection accessory mounted in the Bruker IFS 88 allows to measure bi-directional reflectance of minerals at room temperature, under purging conditions in the extended spectral range from 0.4 to $16 \mu\text{m}$. The reference background used for this spectral range is halon deposited on a full sample cup. The reference and the samples are placed in a rotating sample cup holder for the measurements, so to remove possible effects of non-homogeneity in the samples.

All the measurements were taken with 4 cm^{-1} spectral resolution, 4 mm aperture and 500 scans.

5. Results

All spectra show the typical fundamental molecular vibrational absorptions of the SO_4^{2-} ion occurring in the far-IR [2] with several weaker overtones and/or combinations bands located in the mid-IR [3] with the depth of these absorptions varying with particle size, as expected (Fig.1). The SO_4^{2-} ion itself does not produce absorptions in the visible and near-infrared spectral range [4] resulting in the generally high reflectance in this region. All samples, however, appear to contain some $\text{H}_2\text{O}/\text{OH}$ indicated by weak absorptions in the near-infrared spectral range at 1.4, $1.9 \mu\text{m}$ as well as $2.9 \mu\text{m}$.

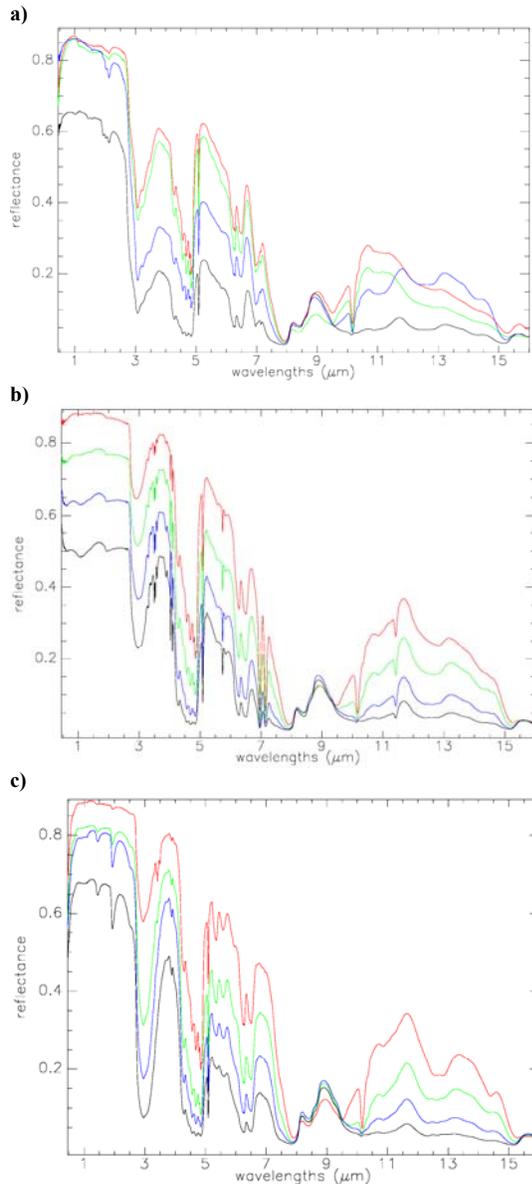


Figure 1: Reflectance spectra of terrestrial massive white to grayish barite samples from a) China, b) Germany and c) Italy.

4. Outlook

As a next step, the determination of major and trace elements within the barite samples will be conducted by X-ray Fluorescence Spectrometry (XRF). Furthermore, barite and the secondary minerals will be analyzed by Powder X-ray Diffraction (XRD).

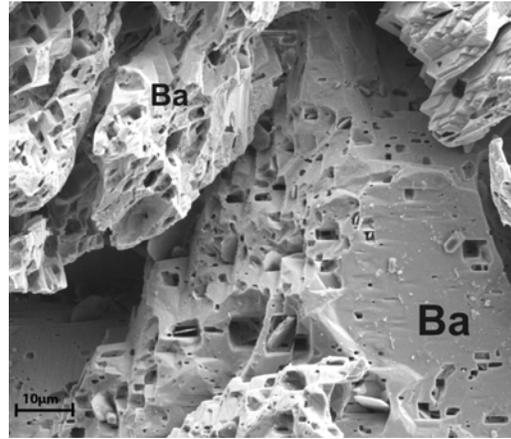


Figure 2: Accessory barite (Ba) with dissolution structures as little rectangular caverns possibly caused by hydrothermal alteration (COORAL-Project, Universität Halle, Germany).

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