Chemical variations in hydrothermal systems recorded by epidote in altered oceanic crust of South China Sea

Liyan Tian [a], Siyu Hu [b], Xuan-Ce Wang [c]

[a] Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences (Sanya, China); [b] CSIRO Mineral Recourses (Perth, Australia); [c] Yunnan University (Yunnan, China)

1. Introduction

The circulation of seawater within the oceanic crust promotes the extensive chemical variations of the lithosphere prior to its entering subduction zones as well as the development of the biosphere. A good understanding of the chemical variations during hydrothermal circulation is essential to further decipher the biological activities in such extreme environments. Epidote is a common byproduct, but a good indicator for hydrothermal activities during the hydrothermal alteration of oceanic crust. This study presents the petrographic and geochemical features of epidote from depth of 850- 910 m (below the surface) in the northern South China Sea margin to provide insights into the possible chemical variations in hydrothermal systems in subsurface.

2. Methodology

Sample Selection

Eight samples with obvious epidote veins were chosen from the altered basalts in IODP 368 Hole 1502B. They cover a range with different depth and occurrences (seen in Figure 1).

Optical Microscope

Thin sections were examined with an optical microscope in order to pick up areas of interest.

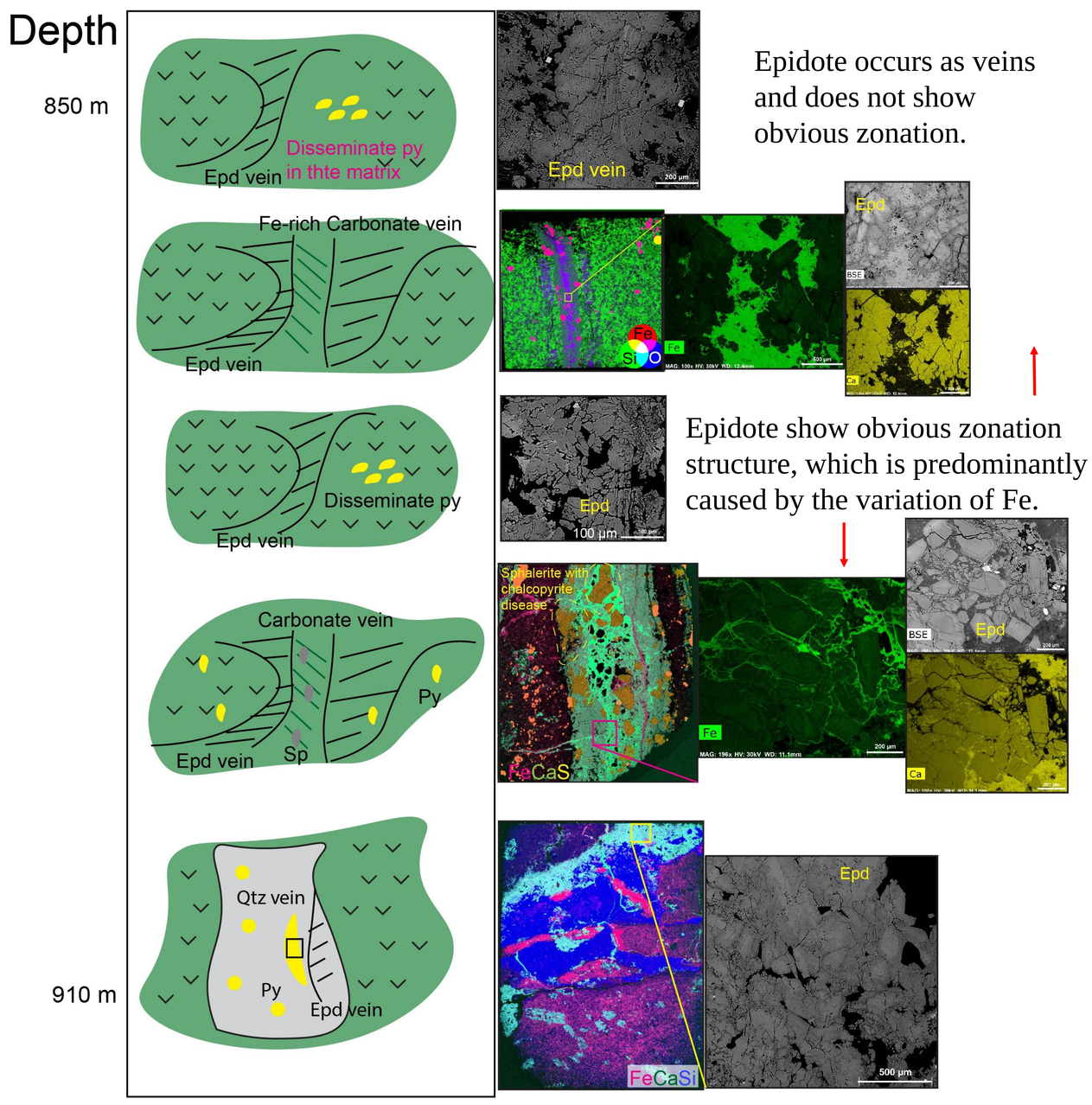
SEM

Scanning Electron Microscopy (SEM) was used to confirm which minerals are present, including epidote. It was also used to obtain major element concentrations of Mg, Al, Si, Ca and Fe.

LA-ICP-MS

Laser Ablation Inductively-Coupled-Plasma Mass Spectrometry was used to obtain trace element concentrations. The CSIRO laboratory used an Aglient 7700 ICP-MS coupled to a Photon Machines 193 excimer laser. NIST 610 and BCR2G were used as calibration standard and Si as internal standard for quantification.

3. Mineralogy



Epidote occurs as veins and does not show obvious zonation.

Epidote show obvious zonation structure, which is predominantly caused by the variation of Fe.

Figure 1: The mineralogy variation of epidote and associated sulfides with the increasing depth.

4. Rare Earth Elements

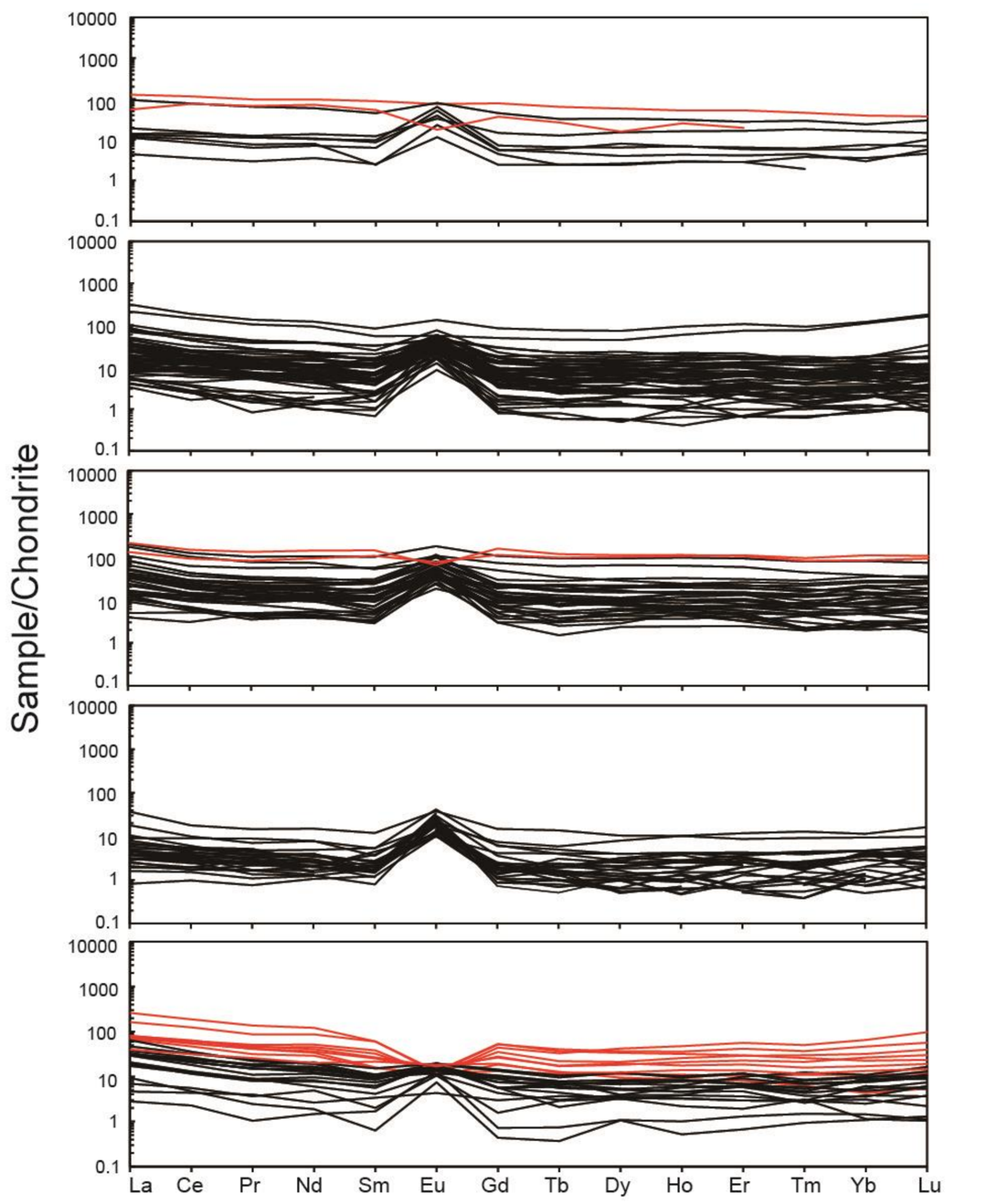


Figure 2: REE plots of selected samples. Normalized value from Palme and O'Neill (2014).

5. Highlights

- Epidote presents various geochemical variations with depth.
- All samples show significant positive Eu anomalies, which may relate to highly oxidized conditions maximising Eu^{3+} incorporation.
- The zonation of epidote may reflect the pulse of hydrothermal activities, one of which is likely to be associated with the precipitation of chalcopyrite and sphalerite.
- Further work (e.g., in situ Sr isotopic analyses of epidote) is needed to determine the fluid evolution trend.

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FOR FURTHER INFORMATION

Liyan Tian

Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences, Sanya, 572000, China (lytian@idsse.ac.cn)

Siyu Hu

CSIRO Mineral Recourses, 26 Dick Perry Avenue, Kensington, WA, 6151, Australia (siyu.hu@csiro.com)