

**Timing of oil-gas charging in the paleo-oil-gas reservoir at the Jinding Zn-Pb deposit and ambient P-T conditions: Significance for bacterial sulfate reduction (BSR) and mineralization**

Guoxiang Chi\*, Chunji Xue, Xianda Sun, Jianqing Lai, Peng Luo, Sheng Li, Hao Song, Rong Zeng

\*Department of Geology, University of Regina, Regina, Canada, SK, Email:  
guoxiang.chi@uregina.ca

The formation of the Jinding Zn-Pb deposit in western Yunnan Province, southwestern China, has been related to a paleo-oil-gas reservoir based on abundant occurrence of bitumen, free oil and gas, as well as oil inclusions in the ores. However, no concrete evidence has been provided to support the notion that the paleo-oil-gas reservoir was developed before mineralization (and playing a role in mineralization). Furthermore, the sulfur isotope data indicate that the sulfur in the ore sulfides is mainly of bacterial sulfate reduction (BSR) origin, but the homogenization temperatures of fluid inclusions from the hydrothermal minerals in the ores are largely higher than 100°C, which casts doubt about whether the thermal condition at the site of mineralization is suitable for BSR. In this study, we report the finding of numerous tiny oil inclusions in growth zones of sphalerite, the major ore mineral in the Jinding deposit. The development of primary oil inclusions in the ore minerals suggests that oil was present before the arrival of the metal-carrying fluids or before mineralization. Detailed petrographic and microthermometric studies of the oil and gas inclusions in detrital quartz grains (secondary inclusions), sphalerite (primary and secondary inclusions) as well as celestine (pseudo-secondary or secondary inclusions) suggest that the oil was saturated with gas in the paleo-oil-gas reservoir, implying fairly low fluid pressure. The wide range of homogenization temperatures ( $T_h$ ) of oil inclusions (from ~10° to >180°C) is interpreted to have resulted from heterogeneous trapping of variable proportions of oil and gas in individual inclusions, rendering the  $T_h$  data unusable. However, detailed work using the fluid inclusion assemblage (FIA) concept reveals that many oil inclusions were homogeneously entrapped, and most of them have  $T_h$  values below 100°C. This observation, together with the fact the youngest host rocks of the deposit (the Paleocene Yunlong Formation) was only semi-consolidated in many places, suggests that the paleo-oil-gas reservoir was not buried to great depth. The ambient temperature was possibly below 80°C, which is favorable for bacteria thriving. Episodic hydrothermal activities would increase the temperature around the conduits to above the bacterial survival threshold, but could not eliminate the bacteria in the whole paleo-oil-gas reservoir. The reaction between the  $H_2S$  produced by BSR in the reservoir and the metals brought by the hydrothermal fluids resulted in the formation of the Jinding deposit.