Bicarbonate-rich fluid inclusions and hydrogen diffusion in quartz gangue from the Libcice orogenic gold deposit, Bohemian Massif

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Unusual paleofluid composition is reported for the Libčice orogenic-type gold deposit located in a contact zone of the Central Bohemian Plutonic Complex, Czech Republic. Unexpected bicarbonate-rich fluids and their complex chemistry variations characterize primary fluid inclusions from the main gold-bearing quartz vein. A detailed microthermometry, Laser Raman Micro Spectroscopy and SEM cathodoluminescence study was used in order to decipher fluid history. The results (Zacharias, 2002; Hrstka et al., 2011) indicate the presence of H_2O and H_2O– CO_2–CH_4 (± N_2; H_2S) fluids, the latter displaying variations of the CO_2/CH_4 ratio in the gaseous phase from 6.8 to 0.06. Variation of the CH_4 content across single grains and between different levels of the mine was recorded. The presence of nahcolite, H_2 (up to 6 mole%) and ethane (0–0.2 mole%) in the fluids were also discovered by Raman probe. Potential models for the formation of different types of fluids present in the deposit are discussed, including the genesis of HCO_3^- rich fluids as well as H_2 and C_2H_6 presence in the primary fluid inclusions. The potential influence of organic matter-bearing sediments, as well as the impact of the intrusion of CBPC, re-equilibration and/or re-speciation of fluid inclusions during the post-entrapment history is considered to have the main impact on the complex paleofluid chemistry. Based on the thermodynamic modelling, H_2 diffusion into the fluid inclusions was shown to be the main reason for the CH_4 variation on the scale of a single grain, as well as across the whole vein. Although the exact processes of production/formation of HCO_3^- and H_2 at the Libčice deposit remain open to discussion, reactions in the C–O–H system are considered to be a possible formation mechanism. This work also contributes to our understanding of the importance of post-entrapment modifications and reactions in the C–O–H system on interpretation/ deciphering the processes in orogenic-type deposits.

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