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Fluid inclusion relationships for samples from underground and drill holes at the Xiadian gold deposit, Shandong Province, China

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The Xiadian gold deposit is located in the south-central part of the Jiaodong Peninsula, China. Orebodies in the deposit, mainly hosted in Mesozoic granitoids and structurally controlled by the Zhaoyuan-Pingdu fault zone, occur as disseminated ores commonly in cataclastically altered wallrock. Four mineralization stages are identified based on cross-cutting relationships, mineralogy, and textural features: quartz-pyrite stage (I), gold-bearing fine-grained pyrite-quartz stage (II), polymetallic sulfide-quartz stage (III), and quartz-carbonate stage (IV). Quartz is also classified based on microscopic characteristics in each mineralization stage, including quartz granules with indentation boundaries (I), cataclastic quartz grain assemblage (II&III), and rod-like quartz grains (IV). Petrography, Laser Raman analysis, and microthermometric studies of fluid inclusions for samples (from both underground and drill holes) from the four mineralization stages reveal three types of fluid inclusions: (1) CO_2-H_2O fluid inclusions (C-H type), (2) CO_2-H_2O±CH_4 fluid inclusions (C-H-CH_4 type), and (3) aqueous fluid inclusions (H type). Stage I contains C-H type fluid inclusions and H type fluid inclusions, with a few C-H-CH_4 type fluid inclusions. There are C-H type fluid inclusions and C-H-CH_4 type fluid inclusions, a few H type fluid inclusions, in stages II and III. Stage IV only contains H type fluid inclusions. For the underground samples, total homogenization temperatures of primary C-H type fluid inclusions in stages I and II-III is 272°C~418°C with salinities of 5.2~8.9 wt.% NaCl equiv. and 248°C~334°C with salinities of 4.9~9.3 wt.% NaCl equiv., respectively. The H type fluid inclusions in stage IV totally homogenized at 111°C~217°C and had salinities of 1.8~7.8 wt.% NaCl equiv. The ore-forming fluid in Xiadian evolved from a H_2O-CO_2-NaCl±CH_4 system at medium temperatures and medium salinities in stages I and II&III to a H_2O-NaCl system at low temperature and low salinity in the final stage. For the drill hole samples, total homogenization temperatures vary from 272°C~363°C (C-H type fluid inclusions in stage I) to 191°C~295°C (C-H type fluid inclusions in stages II&III) and to 136°C~217°C (H type fluid inclusions in stage IV). Salinities in stages I, II&III, and IV is 0.7~13.7 wt.% NaCl equiv., 3.9~10.6 wt.% NaCl equiv., and 1.9~14.2 wt.% NaCl equiv., respectively. Total homogenization temperatures remain in a similar range (180°C~300°C) with changing depths (-1185m,-1212.7m,-1375m,-1440m,-1445m) and salinities of all mineralization stages are mainly constant from 2~14 wt.% NaCl equiv. with depth (-1185m,-1375m,-1440m,-1445m). There is a similar homogenization temperature variation according to the mineralization stage in both horizontal and vertical directions, but a different salinity variation: the decline in salinity in stage IV may indicate the end of hydrothermal activity in a lateral direction and an increase in salinity in stage IV may suggest that there is more than one hydrothermal event in the vertical direction. Moreover, salinity at each depth shows a complete variation in all stages, which may imply there is hydrothermal activity at different depths with fluids of similar features.