Low-salinity liquid-rich or vapor-like fluids in a porphyry-type Mo deposit, South Korea

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Small porphyry-type molybdenum (Mo) mineralization, the Geumeum deposit, South Korea is associated with the crystallization of a Cretaceous granodiorite, exsolution of magmatic hydrothermal fluids, and related hydrofracturing. Quartz and molybdenite occur with minor amounts of uneconomic chalcopyrite, pyrite, sphalerite, and galena that precipitated from exsolved magmatic fluids and formed hydrothermal fissure-filling vein ores. Three distinct fluid inclusion assemblages responsible for the precipitation of molybdenite are present in vein quartz. The earliest fluid is represented by low-salinity liquid-rich Type I fluid inclusions, which displayed homogenization temperatures ranging from 298 to 352ºC, and salinities from ~ 0 to 9 wt% NaCl equiv. The intermediate fluid is represented by CO_2-bearing vapor-rich Type IV inclusions, which totally homogenized by vapor disappearance at 327-340°C or vapor bubble expansion at 327-369°C, exhibiting near-critical behaviors. The latest fluid can be represented by vapor-rich Type II fluid inclusions. No microthermometric data were obtained for these latest assemblages as no visible amounts of liquid phases are evident in small inclusions. The oxygen and hydrogen isotopic fluid compositions of the vein quartz ($\delta^{18}O_{SMOW}$ = 4.3 to 6.9 ‰ and δD_{SMOW} = -65 to -84 ‰ at 400°C) is consistent with a magmatic origin with a possible slight influence from meteoric water. Mo mineralization at Geumeum is a product of hypogene hydrothermal processes that was strongly fracture-controlled, highlighting the importance of low-salinity liquid-rich to vapor-like supercritical fluids for the mineralization. It seems likely that the magmas responsible for the formation of the deposit at Geumeum were emplaced at greater depths than those reported for economic porphyry copper deposits in the world. The deposit could thus have survived long periods of erosion, representing the weakly mineralized “base” of porphyry systems in the Gyeongsang Basin, South Korea.