Reequilibration processes in magnetite from IOCG and IOA deposits and their implications for ore genesis and magnetite classification schemes

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Textural and compositional data of magnetite from six well-studied iron oxide-copper-gold (IOCG) and iron oxide apatite (IOA) deposits show that most magnetite grains have been reequilibrated by oxy-exsolution, coupled dissolution and reprecipitation (CDR), and/or recrystallization. The oxy-exsolution of ilmenite occurs only in high-Ti magnetite from the Sossego deposit, whereas recrystallization process is also local and sometimes accompanying with CDR processes. Increasing oxygen fugacity and decreasing temperature with alteration and mineralization may facilitate oxy-exsolution of ilmenite in high-Ti magnetite that decreases Ti in product magnetite. The CDR processes are most common in the studied samples, which are induced by variations in fluid compositions or physiochemical parameters such as temperature and oxygen fugacity. Dilution and cooling of the hot metalliferous fluids by mixing with meteoric fluids are the main mechanisms responsible for CDR processes and metal precipitation. CDR processes have significantly modified the minor and trace element compositions of magnetite, notably minor and trace elements Si, K, Ca, Mg, Al, Mn, and Ti. With progressive CDR process, minor and trace elements are excluded and Fe contents in magnetite also increased to a various extent. This study highlights that CDR process is an important mechanism for Fe grade improvement in magnetite and also record Cu precipitation from hydrothermal fluids in IOCG system. This study demonstrates that magnetite is much more susceptible to textural and compositional reequilibration than previously thought. The reequilibrated magnetite has geochemical compositions that may be different from its precursor, complicating used of deposit type and precipitation environments discrimination diagrams. Therefore, in situ chemical analysis of magnetite combined with textural characterization is very important to understand the origin of magnetite and the fluid evolution of IOCG and IOA deposits.