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First U-Pb apatite age constraints on the Oumjrane sediment-hosted Cu-Pb-Zn-Ba deposit (Eastern Anti-Atlas, Morocco)

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Sediment-hosted copper deposits account for ~23% of global Cu resources in addition to significant amounts of metals such as Co, Ag, and Au. This class of ore deposits is gaining importance as a source of critical raw materials with the increasing global demand for these commodities. In Morocco, the Oumjrane Cu-(Pb-Zn-Ba) deposit, with indicated resources of 5 million metric tons grading 1.5% Cu, is one of the top three major copper producers in North Africa. The lack of reliable ages for mineralization has left the timing of mineralization as the subject of ongoing debates. This contribution reports the first results of absolute age constraints on the timing of mineralization for the Oumjrane deposit from in-situ U-Pb geochronology of ore-related apatite. The host rocks consist of a succession of Ordovician lower greenschist-facies siliciclastic metasediments comprising the sandstone- and quartzite-dominated lithotypes. In the mine area, copper mineralization consists of transtensional, mostly NE- to E-W-trending, sub-vertical veins, veinlets and “en echelon” tension gashes and breccia veins. Paragenetically, two main sulfide stages are recognized. The earlier Cu-rich stage I consists predominantly of chalcopyrite (>90%) whereas the later Pb-Zn-Ba stage II comprises galena and sphalerite. Quartz is by far the main gangue mineral with subordinate apatite, siderite, and barite. Texturally and compositionally, two distinct apatite generations referred to as apatite I (Ap-1) and apatite II (Ap-2) are recognized. Both generations of apatite are intimately intergrown with sulfides, suggesting coeval precipitation. Hence, dating of apatite is a good proxy for the age of mineralization. U-Pb ages of 175.6 ± 1.5 Ma (MSWD = 1.3, 2σ) and 151.3 ± 3.1 Ma (MSWD = 0.46, 2σ) constrain emplacement of the paragenetically early copper-bearing and the later Pb-Zn-Ba stages, respectively. The association of apatite with sulfides from both stages suggests that metals were transported by a phosphate complex. Geodynamically, the time span ascribed to age emplacement of Oumjrane Cu-Pb-Zn-Ba ore coincides with the breakup of Gondwana and subsequent opening and spreading of Central Atlantic and Tethys Ocean.