U/Pb and REE LA-ICPMS analyses on apatite and scheelite as tracers of fluid circulations for the polyphased W-Au Salau ore deposit (France)

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The Salau deposit is the most important tungsten ore deposit ever mined in France, with a production of 14 kt WO_3. Potential resources remain important because of its probable extension both downward and westward all the way to the W-Au Aurenere workings (Spain). At Salau, two ore types have been mined at the contact between the La Fourque granodiorite and the Devonian marble series. The first one is a grossular/hedenbergite skarn with fine-grained scheelite and disseminated pyrrhotite spatially restricted to the contact with the intrusion. Conversely, the second one, represented by coarse-grained scheelite, massive sulphides, native bismuth and electrum is hosted by ductile-fragile shear zones that crosscut the La Fourque granodiorite and pervade the skarn. To characterize these two ore types, REE LA-ICP-MS analyzes have been performed on scheelites and apatites of each ore type. REE spectra show that fine-grained scheelite has a strong negative Europium anomaly, which is absent in the coarse-grained scheelite. Apatites exhibit the same REE spectra than corresponding scheelite, which implies that the two ore types cannot be derived from the same hydrothermal event. To bring some time-constraint on these fluid circulations, U/Pb LA-ICP-MS dating have been performed on zircon, apatite and scheelite belonging to the two ore types. The emplacement age (U-Pb on zircon) of the La Fourque intrusion, and therefore the age of the fine-grained scheelite skarn, has been measured at 295 ± 2 Ma. This intrusion must have cooled down relatively quickly as the magmatic apatite yielded the same age within error at 297 ± 7 Ma. Interestingly, results on hydrothermal apatite related to massive sulphide ore, yielded a younger age at 289 ± 2 Ma, comparable with the age of 286 ± 4 Ma obtained on coarse-grained scheelite. These results suggest that both ore types may be linked to two distinct fluid circulations separated by at least ca. 2 Myrs. It is proposed that coarse-grained scheelite and the associated electrum may be related to localized fluid circulations within shear zones linked to a magmatic heat source at depth.