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A Devonian Re-Os Age for the Bou Azzer Co-Ni-As Deposit, Morocco

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The Co-Ni-As deposits of Bou Azzer floored by the Anti-Atlas Supergroup have a rich orogenic history reaching back to the Mesoproterozoic. Relicts of a rift-generated, then obducted oceanic crust hosting the Bou Azzer mineralization present as highly sheared ~760 Ma allochthonous ophiolite complexes intruded by younger Neoproterozoic quartz diorites. Prevailing models advocate Neoproterozoic, Variscan, and/or Late Triassic ore genesis. Although analytically challenging, Re-Os dating of micron-scale molybdenite (MoS_2) intergrown with the cobalt arsenide ore mineral skutterudite provided the first indication for a Devonian mineralization event (400-350 Ma-1).

Here, we present new Re-Os ages derived from a newly discovered, unusual molybdenite occurrence underground. Syn-kinematically deformed with widespread chlorite, molybdenite exhibits polished mirror-like surfaces and woody textures. SEM photos show felt-like masses of poorly crystalline to near amorphous molybdenum disulfide (jordisite). Chalcopyrite is widely present, as are tiny cobaltite (CoAsS) crystals. Mistakenly described as sphalerite, an adamantine yellow to red translucent enstatite (MgSiO3) occurs in its rare pure end-member form. Coffinite, a uranium silicate rarely seen as crystals, forms clusters of spectacular tetragonal crystals. Clausthalite (PbSe) is widely present. Most striking, however, is the widespread presence of significant carbon in both sulfides and silicates. Our results outline two distinct events at 385-390 and 375 Ma for molybdenite-chalcopyrite-cobaltite-skutterudite deposition. The 375 Ma molybdenite-bearing event has significant common Os yielding an isochron with an initial 187Os/188Os suggesting influx of primitive fluids in the Devonian.

Proterozoic shales as source rocks are difficult to reconcile with these Re-Os data. Rather, Devonian mineralization appears to have involved fluids from the mantle and potentially Neoproterozoic oceanic crust. The widespread association of carbon with the mineralizing system has yet to be reconciled, but is critical to the ore deposit model.

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1-Oberthür, Stein et al (2009) Economic Geology 104: 1065-1079.