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Multistage Mineralization Indicated by the Re-Os Geochronology of Low-Level, Highly Radiogenic Sulfides at the Kamioka Pb-Zn Skarn Deposit, Central Japan

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The Hida metamorphic belt in central Japan is thought to be a remnant of the Asian continent prior to the opening of the Japan Sea around 15 Ma. The Kamioka skarn deposit, located in the southeastern part of the Hida metamorphic belt, is the largest Pb-Zn producer in Japan. Despite the extensive literature on the deposit geology, geochronology of the Kamioka deposit has been a topic of much controversy [1,2,3]. Although the orebodies are spatially associated with the Triassic to Jurassic igneous and metamorphic rocks, reported ages are mainly restricted to Paleocene, which may represent the episodes of overprinting mineralization [1].

Here we investigated the Re-Os isotope composition of sulfide (chalcopyrite, arsenopyrite, galena, sphalerite) from four orebodies in the Kamioka deposit. Data points (n = 28) were highly scattered on the $^{187}Re/^{188}Os$ vs. $^{187}Os/^{188}Os$ diagram and could not define an isochron age. Therefore, we calculated the single model ages for 10 samples, which were low-level, highly radiogenic (i.e., ^{187}Os composes more than half of the total Os [4]). One chalcopyrite separate from the Sasahira orebody yielded a model age of 176 ± 19 Ma, which is close to the ages of the Hida younger granites found near the deposit (209–176 Ma, determined by zircon U-Pb, whole-rock Rb-Sr and hornblende K-Ar [5]). Model age of 136.7 ± 19 Ma for one arsenopyrite separate from the Sanotsu orebody is in good agreement with the whole-rock Sm-Nd age of ore from the different part of the deposit, dated ca. 150 Ma [2]. The model age is also within the range of the K-feldspar K-Ar ages of the Inishi migmatite (56–162 Ma [3]), which is in close contact with the Kamioka orebodies.

In contrast, eight arsenopyrite separates from the Izumidaira fault yielded much younger model ages ranging from 41 to 19 Ma. While no igneous rock of such age is known in the Kamioka area, fission-track thermochronometry of zircon collected along the Atotsugawa fault zone, on top of which the Kamioka deposit is located, suggests the presence of hydrothermal fluid activity along faults until 15 Ma [6].

Based on the evidence above, we consider all of our model ages to be geologically meaningful, indicating that the Kamioka deposit was formed from multistage processes that occurred over millions of years. Details of different mineralization episodes and directions for future studies will be discussed in the presentation.

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