1 Introduction

The De’erbugan metallogenic belt is located within the eastern Mongolia–Okhotsk Orogenic belt, and is a highly prospective area for Cu–Mo–Au polymetallic mineralization, with several large–medium Ag, Pb, Zn, Au, Cu, and Mo deposits discovered in this region in recent years. However, the precise timing of the polymetallic mineralization and the geodynamic setting of this area are still unknown. This study provides the first age data of the Late Paleozoic Handagai skarn Fe–Cu deposit (zircon U–Pb ages of 359.4 ± 1.4 to 319.0 ± 0.9 Ma) and the Early Cretaceous Taolaituo porphyry Mo deposit (zircon U–Pb ages of 145.2 ± 0.5 to 138.5 ± 0.8 Ma, and molybdenite Re–Os isochron age of 133.8 ± 1.2 Ma), two newly discovered deposits within this region in recent years. However, the precise timing of the polymetallic mineralization and the geodynamic setting of this area are still unknown. This study provides the first age data of the Late Paleozoic Handagai skarn Fe–Cu deposit (zircon U–Pb ages of 359.4 ± 1.4 to 319.0 ± 0.9 Ma) and the Early Cretaceous Taolaituo porphyry Mo deposit (zircon U–Pb ages of 145.2 ± 0.5 to 138.5 ± 0.8 Ma, and molybdenite Re–Os isochron age of 133.8 ± 1.2 Ma), two newly discovered deposits within this region. In conjunction with published data, we identify multiple tectonothermal events associated with the formation of mineralization within the De’erbugan Belt and adjacent areas.

2 Multiple Mineralization Events within the De’erbugan Belt and Adjacent Areas

The geochronological data obtained from ores and associated host rocks during this study (Appendix) allow the mineralizing events in the De’erbugan Belt and adjacent areas to be divided into three distinct stages. These events include subduction of Paleo-Asian Ocean crust (416–320 Ma) associated with the generation of porphyry–skarn Mo–Cu–Fe, hydrothermal Ni–Co–As ± Cu, epithermal Au ± Hg, and greisen Sn–W deposits and mineralization; subduction of Mongolia–Okhotsk Ocean crust (240–160 Ma) associated with the formation of porphyry Mo–Cu–Zn and epithermal Ag–Hg–Sb ± Cu deposits, and greisen Mo–W and granite-type Li–Ta mineralization; and a final post-collisional extensional stage (160–130 Ma) associated with the formation of polymetallic porphyry–epithermal–subvolcanic hydrothermal–altered rock type Pb–Zn–Ag–Au–Mo deposits.

3 Tectonic Setting of Mineralization within the De’erbugan Belt and Adjacent Areas

The De’erbugan Belt is located in the eastern Central Asian Orogenic Belt (CAOB), within the southern margin of the Mongolia–Okhotsk Orogenic Belt. This area is also close to Paleo-Pacific Ocean subduction zone, and, as such, the metallogenesis of this area is closely related to the evolution of the Paleo-Asian, Mongolia–Okhotsk, and Paleo-Pacific oceans. The geological and geochemical data presented here suggests that the polymetallic mineralization within the De’erbugan Belt formed during three distinct mineralization events, at 416–320, 246–160, and 160–130 Ma. These events are linked to subduction of Paleo-Asian Ocean crust, subduction of Mongolia–Okhotsk Ocean crust, and a post-collisional period of extension, respectively.

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