New insights into the evolution of the Mongol-Okhotsk orogenic belt from northeastern Mongolia

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Suturing between Mongolian terranes and the Siberian craton resulted from closure of the Mongol-Okhotsk Ocean, for which the details regarding the timing and mechanisms of closure of the ocean basin remain a significant focus of research in the international tectonics community. We present new field, (micro)structural, and $^{40}Ar/^{39}Ar$ data from areas from the Ereendavaa and Adaatsag terranes (Badarch et al., 2002) in northeastern Mongolia. This area of study is inferred to overlap with the Mongol Okhotsk suture zone, at least in part, to the southwest of the Onon Island Arc. The Adaatsag and Ereendavaa terranes have been interpreted as an accretionary wedge and an early Paleozoic active margin that developed above subducted oceanic lithosphere, respectively (e.g., Miao et al., 2017). The Ereendavaa metamorphic core complex (EMCC) developed along a section of this boundary during the Early Cretaceous (c. 138–125 Ma) (Daoudene et al., 2009, 2013) in association with shearing along the northwest-dipping Onon shear zone, perhaps reactivating a segment of the suture. The lateral extent of the shear zone and core complex, however, is not fully constrained.

Our new data from the previously mapped footwall of the EMCC are broadly consistent with the findings of Dauodene et al. (2009, 2013). The EMCC, as documented by these authors, preserves two different structural trends of stretching lineations in rocks with mylonitic fabrics in the footwall of the EMCC (~NE-SW-trending and ~NW-SE-trending lineations). We targeted samples associated with both trends and obtained Early Cretaceous $^{40}Ar/^{39}Ar$ ages in every case. The significance of the two (?) trends is still uncertain, though locally observations suggested the NE-SW-trending lineations may be younger and possibly associated with a component of left-lateral shear.
Approximately 100 km along strike of the EMCC to the northeast, samples of mylonitic "Precambrian basement" revealed greenschist-facies metasediments from which biotite separates from three samples yielded an Early Cretaceous (c. 124 Ma) plateau age, as well as complex spectra with age gradients (130–50 Ma; 84–16 Ma) suggesting partial mid-to-Late Cretaceous and Cenozoic resetting.

Approximately 45 km and 125 km southwest of the EMCC along the southeastern flank of the Ulz Gol, we obtained further Early Cretaceous (c. 130 Ma) $^{40}Ar/^{39}Ar$ ages from mylonitic rocks with both sedimentary and granitic protoliths, respectively. The apparent age spectra show variable degrees of resetting in the mid-Cretaceous. The Early Cretaceous age from the mylonitic granite was obtained from the northwestern margin of the batholith dated by Tomurtogoo et al. (2005) at c. 172 Ma (U-Pb zircon age) that is cut by the WNW-striking Muron Shear Zone, thus constraining the maximum age of the shear zone. We made observations ~30 km along strike in the Muron Shear Zone and documented normal-oblique dextral shear sense (top-to-the-west) in mylonites with south–southwesterly dipping foliations. $^{40}Ar/^{39}Ar$ dating to further constrain the timing of shearing is a work in progress.

In the hanging wall of the EMCC, in rocks of the Adaatsag Terrane, we primarily observed folded and variably metamorphosed metasediments, many of which appear to have turbidite protoliths. Metamorphic grade generally decreases to the north, consistent with the work of Bussein et al. (2011) who reported evidence for Permian–Triassic turbidites in this region. $^{40}Ar/^{39}Ar$ dating of biotite yielded a 186 Ma plateau age, which further helps to constrain the timing of convergence.

To the northeast, in the Duch Gol Basin, rocks proximal to sediments mapped as Upper Permian record metamorphism at greenschist-facies conditions and foliations are crosscut by quartz veins with orientations consistent with a northwest-southeast extensional overprint. White mica yielded an argon spectrum with a 223–192 Ma age gradient and a 130 Ma minimum age.

Similar Late Triassic to Early Jurassic age gradients were obtained from several localities in rocks of the Khentii Batholith along the northwest flank of the Ulz Gol. In some cases, what appeared to be undeformed granitoids in outcrop displayed microstructures consistent with solid-state dynamic recrystallization. The preservation of these microstructures suggests rapid cooling. A sample of a protomylonitic granitoid yielded similar results. Based on the biotite and K-feldspar apparent age spectra from both samples, deformation is interpreted to be Early–Middle Jurassic in age.

We documented metasomatized Ordovician granitoids spatially associated with mylonitic, olivine-bearing marbles in both the Ulz Gol region and the EMCC. The Ordovician magmatic rocks in both the Ulz Gol and EMCC regions were attributed by Miao et al. (2017) to northwest-directed subduction beneath the Ereendavaa terrane during closure of the Kherlen ocean. The metasomatism appears to be Carboniferous in age based on the age of biotite observed in thin section to be replacing hornblende in the Ulz Gol area sample.

Our new $^{40}Ar/^{39}Ar$ age data extend the range of Early Cretaceous ages obtained from mylonites to both the northeast and southwest along strike of the EMCC by 100 km or more. Many of the rocks in the EMCC and its apparent extent are metasedimentary lithologies. Late Paleozoic and Early Mesozoic ages were obtained from samples in the hanging wall of the EMCC, as well as from deformed granitoids and gneisses along the northern flank of the Ulz Gol basin to the southwest. Ordovician granitoids spatially associated with mylonitic, olivine-bearing marbles in both the Ulz Gol region and the EMCC record metasomatism that may be Carboniferous in age. Rocks flanking both the Onon and Ulz Gol basins to the northeast and southwest of the EMCC, respectively, preserve evidence for multiple phases of deformation. Minimum $^{40}Ar/^{39}Ar$ ages obtained from samples along these structural corridors that display brittle overprints suggest mid-Cretaceous and Cenozoic phases of fault reactivation.

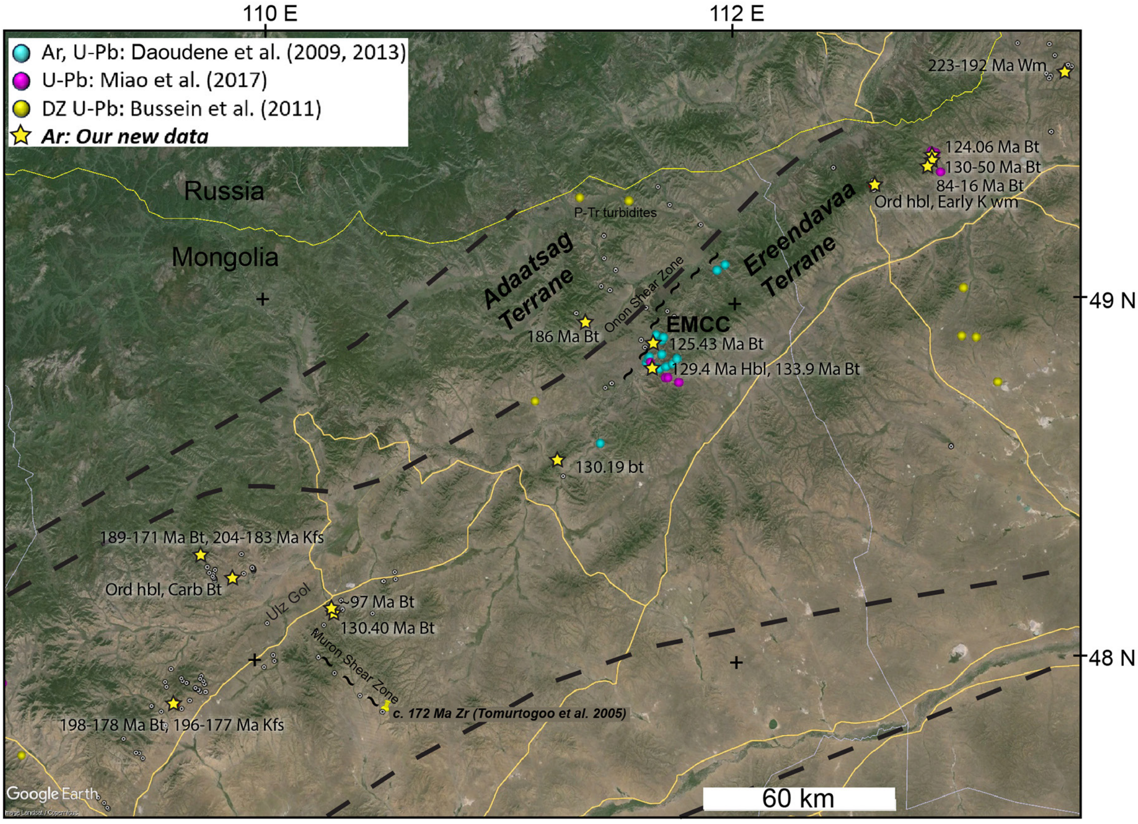

Figure 1: Google Earth satellite imagery showing locations of samples, observations, and $^{40}Ar/^{39}Ar$ data described in the text in relation to data from previous studies. EMCC = Ereendavaa Metamorphic Core Complex. Terrane boundaries from Miao et al. (2017).

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