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IMPROVED U-PB DATING OF THE CA. 450 MA SUORDAKH MAFIC EVENT IN EASTERN SIBERIA WILL TEST WHETHER THIS IS THE MISSING LIP RELATED TO END-ORDOVICIAN MASS EXTINCTION

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The Suordakh north-south trending mafic dikes and associated sills are currently recognized over an area of 11,000 km^2 in the Verkhoyansk region of eastern Siberia (Figure 1), but candidates are possible over an area that is approximately 500 km long and 80 km wide (Khudoley et al. 2013). "Moreover, the intensity of magmatic activity increases northward and eastward, although in both directions the Paleozoic rocks of the Sette–Daban Range are obscured by the Carboniferous siliciclastic units of the Verkhoyansk Complex" (Khudoley et al. 2013) and so the full extent could plausibly reach Large Igneous Province (LIP) scale (minimum of 100,000 km^2; Ernst, 2014).

Recent in-situ SIMS U-Pb baddeleyite dates (Schmitt et al. 2010; Chamberlain et al., 2010; Khudoley et al. 2013; Chamberlain, unpublished data) coupled with an ID-TIMS U-Pb baddeleyite date (Khudoley et al. 2001), establish that the Suordakh swarm is ca. 450 Ma. The precisions on the existing dates are low enough however, that there could be several discrete magmatic events within the sampled dikes and sills, with additional events ca. 420 Ma and 380 Ma. Ongoing research is focussed on 1) improving the precisions of ages on existing samples from ±10% to ±1% or better, 2) collecting samples from nearby regions to test for the areal extent of the events, and 3) studying the composition and tectonic setting of the Suordakh mafic intrusions (see papers by Khudoley & Prokopiev and by Savelev & Lebedeva, this volume).

Higher precisions on the ages of the Ordovician-Silurian mafic intrusions will: 1) determine how many events are present and 2) determine the temporal relationships, if any, between these intrusions and phases of the end-Ordovician extinction.

In-situ SIMS U-Pb baddeleyite dates from 6 mafic dike and sill samples from Sette-Daban range from 457±34 to 379±27 Ma (Figure 2), based on 2 to 8 spot analyses each. The thin sections from these samples have been remapped with improved x-ray mapping techniques leading to the identification of 25 or more additional target grains in each (e.g. Figure 3). SIMS date precisions are likely to improve by averaging 12 to 15 spots from each sample. In addition, many of these samples have baddeleyite grains that are >20 microns in size and are separable by the Sõderlund method (Sõderlund and Johansson, 2002) for higher precision, dissolution, ID-TIMS dates. Preliminary ID-TIMS data from one sample demonstrate more discordance than the corresponding SIMS data, so these additional analyses will also test and clarify discordance mechanisms produced by both dating methods.

The end-Ordovician glaciation event and its mass extinction has been an anomaly since it is the sole major mass extinction that is not yet associated with a LIP (Ernst 2014). The temporal link between LIPs and other extinction events is robust. Many major, and some minor, LIP events occur within several million years or less of global extinctions (e.g. Courtillot and Renne 2003; Wignall 2005; Ernst 2014; Bond and Grasby 2016; Ernst and Youbi, 2017). The most compelling examples are currently the Deccan (c. 66 Ma), Central Atlantic Magmatic Province (CAMP; 201 Ma), and the Siberian Trap (252 Ma) LIPs, whose current dating overlaps precisely in age to the Cretaceous–Tertiary, Triassic–Jurassic, and Permian–Triassic boundary extinctions, respectively (Blackburn et al. 2013; Burgess and Bowring 2015; Schoene et al. 2010, 2015). Improving the age precisions on the Suordakh mafic event will test whether this is the missing LIP for the end-Ordovician extinction.

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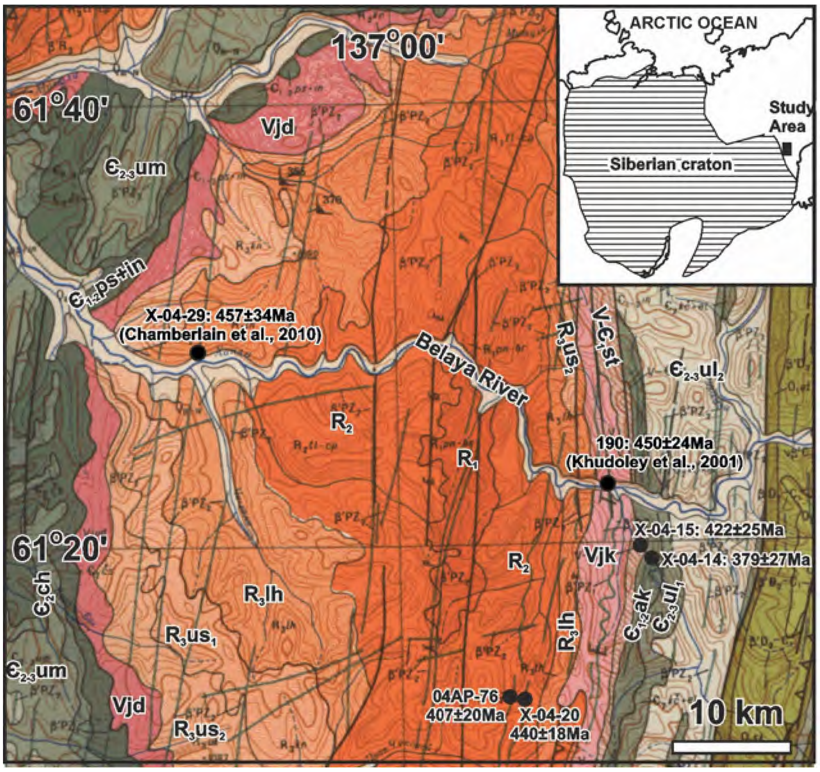

Fig. 1: Regional geology and sample locations from Sette-Daban, eastern Siberia. Mafic dikes and sills are indicated by dark lines. Mesoproterozoic Riphean formations (R_x) are indicated in shades of orange.

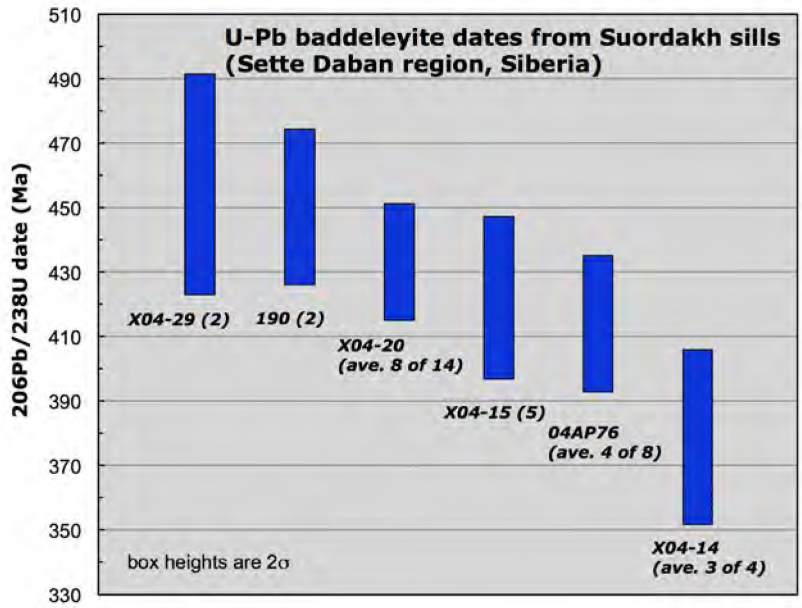

Figure 2. Summary plot of existing U-Pb dates from Ordovician to Silurian mafic sills and dikes in the Sette-Daban region, Siberia. At least two periods of magmatism are indicated by the range of dates, ca. 450 and 380 Ma, but better age precisions will improve the constraints on these 2 periods and potentially identify a third ca. 420 Ma.

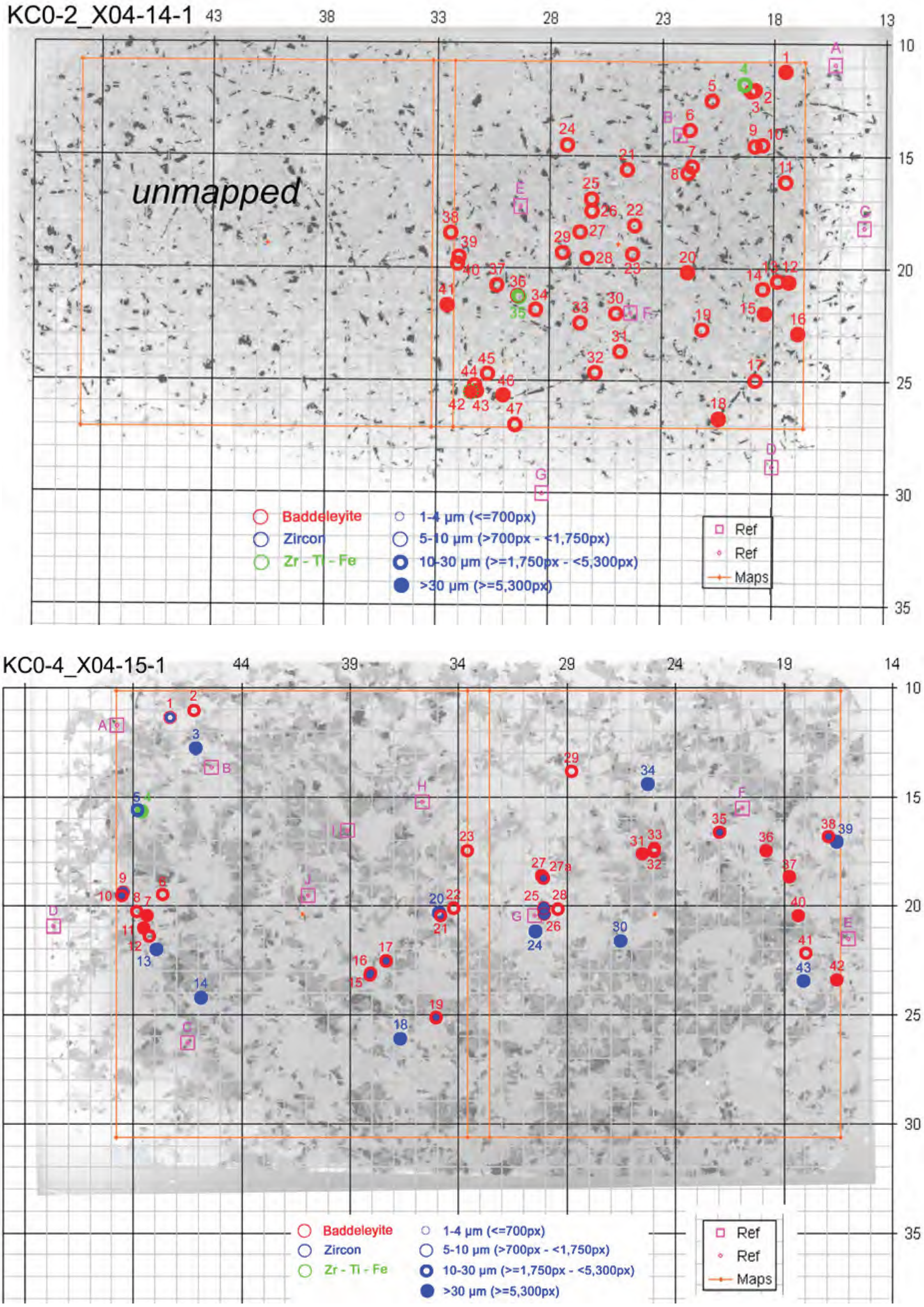

Figure 3. Full thin section maps of locations of baddeleyite (red) and zircon (blue) in mafic samples from the Suordakh sills based on new x-ray mapping. Previous efforts had only located approximately 10 grains per thin section. Zircon may represent metamorphic growth and will also be dated by in-situ SIMS methods. Grids are in millimeters.