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Kaapvaal, Superior and Wyoming: nearest neighbours in supercraton Superia

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Archean cratons embedded in younger continental amalgamations are fragments of late Archean continents or supercratons. Of the ~35 remaining large cratonic fragments, the Superior craton represents one of the larger and better preserved fragments and was a central and defining piece of supercraton Superia [1]. This supercraton, the full extent of which remains to be determined, underwent progressive rifting and breakup during the Paleoproterozoic, spawning ~10 cratonic fragments that were dispersed by plate tectonic movements. Previous work already has shown that Wyoming, "greater Karelia" (i.e. Karelia+Kola), Hearne and a number of other cratons were integral parts of supercraton Superia [e.g., 2, 3]. Specifically, Wyoming craton and Hearne, and "greater Karelia" are fragments that rifted off the southern Superior craton (present reference frame).

New work argues that the Kaapvaal craton of southern Africa (and therefore also Pilbara, as part of Vaalbara) was another integral part of Superia, representing the fragment that originated from the re-entrant to the southwest of a combined Superior-Wyoming. A new paleomagnetic interpretation, across more than one time slice, is fully compatible with this interpretation. A large number of remarkable geological correlations and new predictions follow from this reconstruction that will allow a full integration of the Archean and pre-breakup Paleoproterozoic records of these well-known cratons now scattered around the globe. At the core of this reconstruction is the equivalence of the following terranes: 1) the ancient gneiss terrane of the eastern Kaapvaal, 2) Minnesota River Valley (MRV) terrane of the southern Superior, 3) the ancient core of Wyoming craton, and likely also, off to the east, 4) the ancient core of Karelia. All these terranes share a fundamentally similar ca. 3.7-3.2 Ga history and represent a single high-μ domain of ancient crust that collided at ca. 2.65-2.62 Ga with the southern flank of the growing Superia landmass. After ~600 Myr residence in the supercratonic landmass of Superia, progressive breakup dispersed the cratonic fragments, and with them remnants of this ancient crust, leaving the MRV terrane stranded in the Superior fragment.

Numerous other predictions follow. For instance, the 2.71 Ga Stillwater layered intrusion is almost certainly an integral part of the Ventersdorp large igneous province (LIP). At later times, BIF deposition in the Transvaal Basin may have been fuelled by exactly coeval magmatism of the Matachewan LIP. The 2460 Ma tuffaceous zircons that date these BIFs likely represent ash that blew in on trade winds from the east, from the main point source of 2460 Ma felsic volcanism in the lower Huronian [4]. Hekpoort basaltic volcanism of the Transvaal is probably the extrusive equivalent of the enormous 2210-2220 Ma Nipissing-Karjalitic sill province, now also identified in Wyoming. As full breakup of southern Superia was likely delayed until ca. 2.01 Ga, there is the distinct possibility of Bushveld-equivalent ages (2056 Ma) in adjacent fragments of Superia. Indeed, we have dated a 2056 Ma dyke in the western Superior. Although somewhat more distant, the 2050-2060 Ma magmatism of northern Karelia and Kola may be distal expressions of the same tectonic system, on different parts of the same supercraton-scale plate

(Superia). The growing reconstruction of Superia, informed to a large extent by precise U-Pb dating and correlation of Precambrian LIPs, as envisaged a decade ago [2, 3], and now also extending to Kaapvaal and Pilbara, sets the stage for an in-depth synthesis of the rich Archean records of these cratons and their Paleoproterozoic cover sequences, including a detailed sequence stratigraphic correlation of the Huronian and Transvaal basins.

References:

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