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Hidden metamorphic discontinuities in the NE Baidrag block, Mongolia, reveal anticlockwise metamorphic paths at c. 890–790 Ma indicating peri-Rodinian back-arc compression followed by c. 560–520 Ma burial

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The Barrovian type metamorphism affecting the Precambrian microcontinents of peri-Siberian tract of the Central Asian Orogenic Belt is mostly dated indirectly on zircon from (syn-tectonic) magmatic rocks as Late Proterozoic – Ordovician. However, in-situ monazite geochronology in micaschists and migmatite gneisses at the northern part of the Precambrian Baidrag block, central Mongolia, revealed that the Baikalian Late Proterozoic – Early Cambrian cycle overprints an earlier Tonian phase of metamorphism. The apparent Barrovian-type zoning ranging from garnet, staurolite, kyanite to kyanite/sillimanite migmatitic gneisses is thus false and points to hidden metamorphic discontinuities and mixed metamorphic histories from different times. Therefore, to decipher and interpret the record of different tectono-metamorphic events it is necessary to unravel complete P–T–t paths from individual samples. Two localities with Tonian-age monazite show anticlockwise P–T paths: 1) Grt−Sil−Ky gneiss records burial to the sillimanite stability field (~720°C, 6.0 kbar) followed by burial to the kyanite stability field (~750°C, 9 kbar) and, 2) The Grt−St schist records burial to the staurolite stability field (~620°C, 6 kbar), further followed by almost isothermal burial (~590°C, 8.5 kbar). Based on monazite textural position, internal zoning, and REE patterns, the time of prograde burial under a thermal gradient of 27–32°C/km is estimated at c. 890−853 Ma and further burial under a geothermal gradient of 18–22°C/km is dated at c. 835−815 Ma. On the other hand three localities with Late Proterozoic to Cambrian monazite ages show clockwise metamorphic paths at variable P–T gradients: 3) P–T conditions of the Grt schist reaches ~5 kbar and 500 °C and 4) the Grt−St−Ky schist reaches conditions of 9 kbar and 670 °C, indicating burial under a geothermal gradient of 20–26 °C/km. 5) Grt–Sil gneiss shows peak of 6–7 kbar and 700–750 °C, indicating melting conditions at 30–32 °C/km gradient. Monazite included in porphyroblasts and in the matrix indicate that these P–T conditions reached under variable geothermal gradient were semi-contemporaneous and occurred between 570 and 520 Ma. By correlation with published zircon ages of 600–530 Ma from granitoid magmatic rocks we suggest that the areas with higher geothermal gradient may be explained by closer vicinity of magmatic

intrusions. These P–T and geochronology data from a continuous Barrovian metamorphic section suggest that anticlockwise P–T evolution from c. 930 to 750 Ma can be interpreted as a result of thickening of peri-Rodinian supra-subduction extensional and hot edifice. This metamorphic event was followed by a clockwise P–T evolution from c. 570 to 520 Ma possibly related to shortening of the northern Baidrag active margin and incipient collision with with peri-Siberian continental mass further north.