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North China's Archean Central Orogenic Belt: An Ophiolitic Mélange-Bearing Witness to Late Archean Oceanic Crust Production and Destruction

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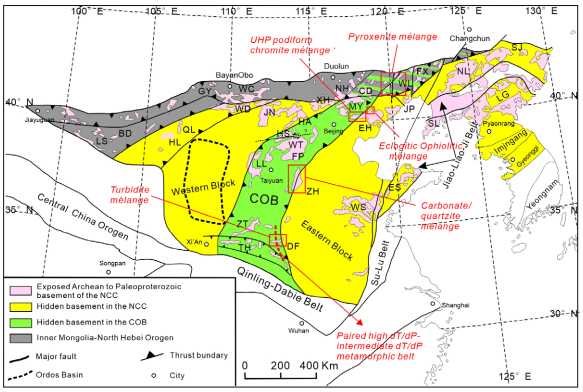

Ophiolites and ophiolitic mélanges record information about processes related to formation of oceanic crust, and closure of oceans in which they formed. Archean ophiolites, ophiolitic fragments, and ophiolitic mélanges are particularly interesting for what they may tell us about oceanic lithosphere, mantle circulation, and tectonic style compared to younger times. North China Craton's 1800 km-long Central Orogenic Belt (COB on figure) records the 2.5 Ga collision of a 2.7-2.5 Ga oceanic arc(s) with a collage of slightly older arcs in an accretionary orogen. The orogen has classical orogenic zones, including a 2.7-2.5 Ga arc(s), fore-arc MORB-boninitic-IAT sequences, fore-arc basinal assemblages, far-travelled sub-horizontal sheath-folded nappes, and a poly-genetic mélange. The belts form a classic medium-low dT/dP high dT/dP paired metamorphic belt. Ophiolitic fragments in the mélange range in size from individual outcrop-sized blocks in metapelitic and locally serpentinitic or mafic matrix, to belts up to several km long. Rock types include serpentinized harzburgite tectonites, rare lherzolites, pyroxenites, garnet pyroxenites, layered gabbro, massive gabbro, local dike complexes, basalts (locally pillowed), cherts, metalliferous deposits, and metapelites. Some blocks have fore-arc geochemical signatures, others have MORB signatures, locally separable into different mappable mélange belts. These belts were thrust over a 2.58-2.50 Ga passive margin-like sequence formed on the back-side of other recently accreted arcs forming the Eastern Block of the craton, and are associated with a 2.50/2.45 – 2.31 Ga foreland basin sequence.

The ophiolitic fragments provide constraints on conditions in Archean subduction zones, oceanic lithosphere, and deeper mantle. An N-MORB garnet pyroxenite block in mélange experienced eclogite-facies conditions, yielding a dT/dP of 11℃/ km, one of the coldest recorded Archean geotherms. This is confirmed by an Alpine-type peridotitic block in the mélange independently yielding a dT/dP of 11℃/ km. Perhaps most remarkably, some podiform chromitites in harzburgites have yielded a suite of crustal and mantle inclusions, including TiO_2(II) stable above 7.5 GPa (~270 km), and the UHP phase of chromite, chenmingite, stable above 14 GPa (~410). These inclusions are similar to those of Phanerozoic ophiolites, demonstrating the operation of deep crust-mantle recycling through plate tectonic processes for at least the past 2.7 Ga.