Herman V. Zwanzig
Manitoba Geological Survey

2004-2005 Howard Street Robinson Lecturer

Dr. Herman Zwanzig of the Manitoba Geological Survey was chosen to give the Howard Street Robinson Lecture tour for 2004-2005. The lecturer is chosen by the Mineral Deposits Division and the Precambrian Division of the Geological Association of Canada (GAC) in alternate years. It is funded by the Robinson Fund of the GAC that was established in 1977, following the bequest to GAC from the estate of Howard Street Robinson, a founding member of GAC. The bequest was "for furtherance of scientific study of Precambrian Geology and Metal Mining."

Abstract

Hot, thin and mineral-rich–evolution of the Paleoproterozoic Trans-Hudson Orogen in western Canada

2004 Robinson Lecture by Herman Zwanzig

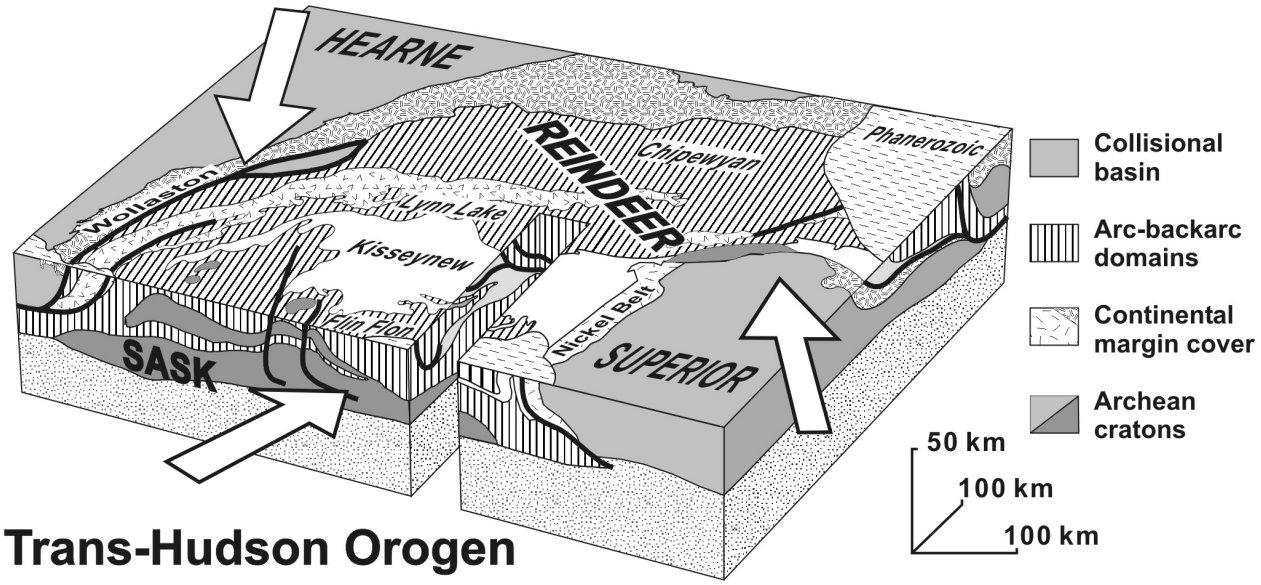
Manitoba Geological Survey, Manitoba Industry, Economic Development and Mines

The Trans-Hudson Orogen (THO) evolved during the Paleoproterozoic era in stages that can best be explained by modern global tectonics. Higher than present heat production, however, resulted in highly mineralized orogenic crust that remained thin during early stages of continental collision.

Evolution of the THO began ca. 2.1 Ga with continental break-up of the Archean Hearne Craton, which was followed by ocean formation and protracted (2.0–1.86 Ga) rifting along the Superior Craton margin. At that time ultramafic magmas in the anomalously thin continental margin sediments of the Thompson Nickel Belt produced the rich nickel deposits.

Coeval continental-margin arc magmatism at the rim of the (Pacific-type) ocean left behind ca. 1.89 Ga plutons, with < 3.4 Ga Nd model ages, near the margins of the internal (Reindeer) zone. Local melting of Archean detritus and rift fragments may be a proxy for modern sediment accretion and blueschist metamorphism. A continental backarc to foreland basin formed in the Wollaston Belt along the Hearne margin and a similar setting may have been present during 1.88 Ga dyke intrusion behind the Superior boundary.

Most 1.90 to 1.88 Ga subduction products throughout the Reindeer Zone are very similar to compositionally primitive modern island-arc and backarc basin volcanic rocks. Cu-Zn deposits are associated with volcano-tectonic subsidence structures. Small gold deposits formed during advanced arc rifting and, finally, mafic intrusions with Ni-Cu deposits (at Lynn Lake) may have formed during subduction flip in the 1.87 Ga transition to successor arc magmatism. During the main period of successor arc magmatism (1.87–1.85 Ga) the LaRonge–Lynn Lake arc had already drifted into and collided with the Hearne margin and caused



deformation of the Wollaston Belt and arcs. The very large Wathaman–Chipewyan granite belt welded these accreted terranes together while the Flin Flon area was still an emerging island arc. Much of the subduction was probably of hot, young ocean floor, causing further compression and thrusting, and forming some plutons directly from melting of the down-going slab.

A third cycle of subduction (1.845–1.830 Ga) most likely 1) consumed the last backarc-basin floor, 2) started continental arc magmatism, 3) caused collision between the Flin Flon Belt and the Thompson Nickel Belt, and 4) resulted in syncollisional sedimentation in the contracting Kisseynew Domain and surrounding down-thrown fault blocks. The youngest Ni deposits in the THO (e.g. Namew Lake) occur in an ultramafic intrusion in the backarc(?). Mantle backflow may have rafted in the Sask Craton, which underthrust the Reindeer Zone. Subsequently, some thrust sheets and tectonic boundaries were completely overturned and strongly rotated as the Superior, Sask and Hearne continental blocks started to override each other. The present arrangement of belts in the THO reflects collision, not subduction. Only sutures southeast of the Hearne margin retain their early dip, showing continued underthrusting, lastly by the collision-generated sediments and gneisses derived from the southern arc fragments. Extensive upper-mantle delamination may have made room for the Sask Craton and its mantle, and triggered the regional high-grade metamorphism (low-medium P) throughout the THO. Fluid flow attending metamorphism of the sediments and crustal melting produced the lode gold deposits in overlying shear zones. Subsequently, the crust thickened during intracontinental transpression (rather than collapsing, as in modern, previously overthickened orogens).