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Late Paleoproterozoic to mid-Neoproterozoic history of northern Laurentia: An overview of central Rodinia

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Abstract

At the assumed core of reconstructed Rodinia, northern Laurentia, comprising the Canadian Shield (including Greenland) and its buried western and northern extensions beneath Phanerozoic cover, is considered in two parts. On its southeast side, the Grenville Province is part of a major late Mesoproterozoic orogen inferred to be related to the assembly of the Rodinia supercontinent. The remainder of northern Laurentia experienced a long period of crustal stability beginning at ca. 1.8 Ga, recorded for the most part by intracontinental and passive-margin sedimentation along with mafic igneous activity, mainly in the mid-Mesoproterozoic, related to limited extension. To the south, this stable part of northern Laurentia is overprinted by late Paleoproterozoic orogeny (Yavapai, Mazatzal, and Central Plains orogens) and early Mesoproterozoic magmatism (granite-rhyolite provinces). Deformed and metamorphosed rocks related to these form a major part of the interior of the Grenville orogen, where mid- to late Mesoproterozoic orogenic events led to accretion of terranes to Laurentia and subsequent terminal collision. The first manifestation of Rodinia breakup began in the west at ca. 0.8 Ga, some 0.2 Ga earlier than along the southeast side; the age of initial rifting along the northern margin is not known.

Keywords: Laurentia; Rodinia; Mesoproterozoic; Neoproterozoic; Grenville orogen

1. Introduction

Laurentia occupies the central part of Rodinia supercontinent in most reconstructions (e.g. Moores, 1991; Hoffman, 1991; Dalziel, 1991; Karlstrom et al., 1999). Laurentia is defined as an amalgamation of Archean cratons (Wyoming, Slave, Superior, Nain) separated or bordered by orogenic belts of differing Proterozoic age (Fig. 1). In northern Laurentia, the latter are primarily mid-Paleoproterozoic (Wopmay, Trans-Hudson, New Quebec, Torngat, Makkovik, Southern); also included are tracts of variably reworked Archean rocks (large parts of Rae and Hearne provinces, Sask craton, Marshfield–Stevens Point in the Southern Province). To the south, the structural framework of northern Laurentia is truncated by late Paleoproterozoic orogenic belts (Yavapai, Mazatzal, and equivalent Central Plains) that trend east-northeast across the midcontinent. These are succeeded to the southeast by early Mesoproterozoic igneous provinces (granite-rhyolite provinces of Bickford et al., 1981; also see Bickford and Anderson, 1993), and in turn by the ca. 1.1 Ga Midcontinent rift system. Younger still, and also truncating all earlier continental structure and redeforming rocks ranging from Archean to early Mesoproterozoic, the late-Mesoproterozoic Grenville orogen extends along the whole southeast and south sides of Laurentia, from the Atlantic coast of Labrador to west Texas (Llano province) and southern Mexico (Oaxaca).

This paper deals with northern Laurentia, much of which is exposed in the Canadian Precambrian Shield, and whose gross structure can be traced beneath Phanerozoic cover by geophysical means westward toward the Cordillera (Fig. 1). In contrast the southern part of Laurentia, is largely buried by Phanerozoic sedimentary rocks and can only be evaluated on a continent-wide basis by its geophysical attributes and isotopic signatures.

For the purposes of Rodinia reconstruction, it is important to try to define the margins of Laurentia that should be used for assembly of the component continental blocks, now widely dispersed. Present day Laurentia (including Greenland) is now bounded by Phanerozoic orogenic belts, namely the Appalachian and Ouachita systems along the east and south sides, the Innuitian belt (Franklinides of Hoffman, 1989) along the northern margin, and the Cordilleran orogen along the west

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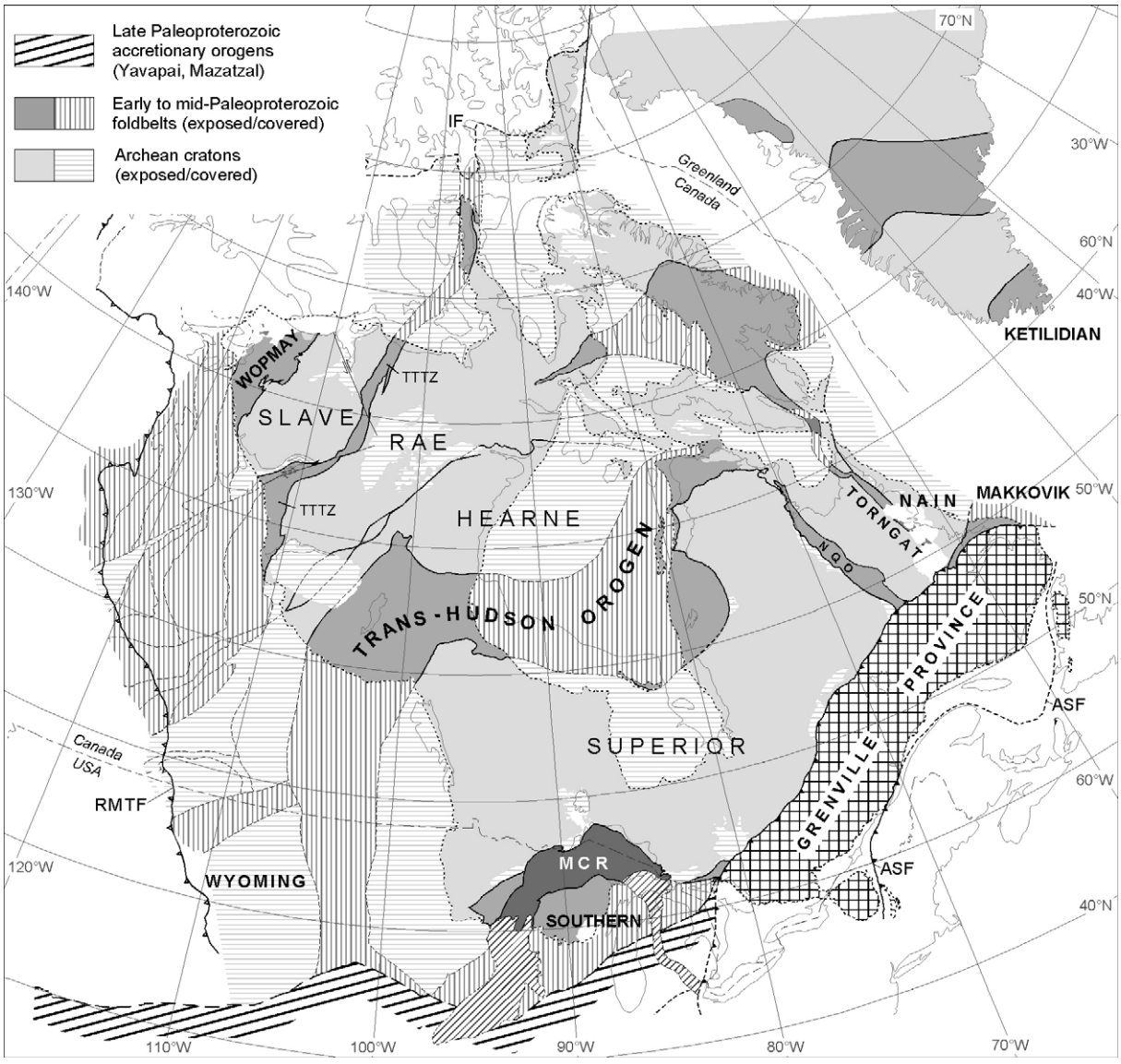

Fig. 1. Disposition of Archean provinces and early to mid-Paleoproterozoic orogenic belts in the North American Craton. Traces of geophysically distinctive blocks beneath cover in the west are from Ross et al. (1991). RMTF, Rocky Mountain thrust front; IF, southern limit of Innuitian folding; ASF, Appalachian structural front; TTTZ, Thelon-Taltson tectonic zone; MCR, Midcontinent rift.

side (Fig. 2A). Rocks that can be correlated with Rodinia are confined to the northeast side of the suture within the Appalachian orogen, known as the Red Indian Line in Newfoundland, whose position is relatively well known (Williams, 1995); on the southeast side of this suture, Avalonia is underlain by late Neoproterozoic rocks whose basement is not known, whereas crystalline rocks recording Grenvillian orogeny are present in inliers on the Laurentian side (Fig. 2B). Within the Innuitian belt, the northern limit of Laurentia lies mainly offshore and its position is not well constrained; however, a suture within this belt clips the northwest coast of Ellesmere Island (Fig. 2A), separating the Precambrian crystalline terrane of Pearya from northernmost Laurentia (Trettin, 1987, 1991). Within the Cordillera, North American crust extends at least as far west as the western limit of the Neoproterozoic Windermere Supergroup, and also includes earlier Mesoproterozoic crystalline inliers plus terranes referred to as pericratonic and displaced continental margin (Gabrielse et al., 1991); the latter were termed proximal and distal terranes by Price and Monger (2003), who showed that much of central and northern Alaska is made up of such terranes (Fig. 2C). In an evaluation of the northern Cordilleran Lithoprobe Transect, Snyder et al. (2002) placed extended North American crust, interpreted as Wernecke Supergroup and younger Meso- and Neoproterozoic assemblages, almost as far west as the Denali fault, postulating that non-North American accreted terranes in the Cordilleran interior (e.g. Stikinia) had been displaced eastward over this crust. South of the Canada–USA border, the western limit of North American crust is considered to coincide with the ^{706}Sr line ($^{87}Sr/^{86}Sr = 0.706$), the northern extension of which was established by Armstrong (1988). Its incursion in northern British Columbia and southwestern Yukon, where it turns southward to encompass the southerly extent of Yukon-Tanana terrane (displaced continental margin), can be explained in terms of thinned or pinched out North American crust under