k32 Radiometric subdivision of the Proterozoic in North America < Grenville, Penokean-Hudsonian, Algoman-Kenoran >

> Theorists are valuable as long as they are stimulating. It is not so important for them to be correct. Observations, on the other hand, are useful only when they are right.
> —Robert P. Kirshner.[1]

Radiometric dates can be found that accord to the Late Grenville orogeny culmination 0.88 Ga (billion years ago) (K-Ar muscovite mica date: Clifford Howard Stockwell, 1964)[2] later revised to 0.955 Ga (whole rock Rb-Sr isochron date and zircon U-Pb date: Stockwell, 1973)[3] and the late Early Proterozoic orogeny (called the *Penokian* in the U.S. and the *Huronian* in Canada) culmination 1.64 Ga later revised to 1.735 Ga. The mountains that were produced are long gone and the orogens are stabilized as part of the North American craton.

The mica K-Ar ages of pegmatites and granites determined for the Grenville mobile belt are close to 1.0 Gy (billion years old), whereas the pegmatites in Canadian Shield rocks to the northwest of the Grenville Boundary(or Front) fault zone are about 2.5 Gy.[4]

The type Animikie Series (the uppermost division of the Huronian System) in their lithology (quartz-carbonate), accord to a passive continental margin, miogeocline model:

In their Great Lakes occurrence across the Minnesota-Ontario border, Animikie sediments occur in outcrop (as about Thunder Bay, Ontario) as undeformed platform sediments on a profound nonconformity cut across basement rocks of the North American craton.

In their southward extent, Animikie sediments thicken greatly towards where they occupy several sedimentary basins in a mobile belt on the northwest side of the Grenville Boundary fault zone. The culminating orogeny of the mobile belt that dates 1.1-1.7 Gy is called the *Penokian* in the U.S. and the *Huronian* in Canada. Synfolded in the Animikie sedimentary strata are 1.3-1.8 Gy intrusive pegmatites. This establishes the minimum age of the Animikie sediments and their Paleoproterozoic age is then known from their inclusions derived from Canadian Shield sources to the north (as now oriented) of detrital (rounded) 2.5 Gy monazites (reddish-brown phosphate mineral, best known as placer ore for thorium, lanthanum, and cerium) and zircons ($ZrSiO_4$, best known as a diamond-substitute gemstone, though beware, it is easily abraded and is radioactive to the small degree that in it U is in the place of Zr).

Other Canadian shield rocks of Paleoproterozoic age occur in the Circum-Ungava mobile belt, supercrustally in Athabaska and Thelon, and supercrustally marginal to where the same thicken in the Coronation-Wopmay mobile belt.

Canadian Shield rocks of Archean age occur in the Superior structural province. The mica K-Ar date 2.39 Gy (Stockwell, 1964)[2] later revised to 2.48 Gy (Stockwell, 1973)[3] found for these is interpreted as the culminating metamorphic-age of an orogeny called the *Kenoran* in Canada and the *Algoman* in America (***Figure k32.1***).[3]

Note: Mica K-Ar ages of pegmatites record an orogeny's culminating metamorphism (which is when the temperature of the mica is low enough for its crystal structure to be closed to Ar leakage). Compared to such, in the same structural province, zircon U-Pb dates of igneous crystallization of granites are consistently older. The field evidence of batholith emplacement is in accordance with the published distribution frequency of Precambrian zircon U-Pb ages in the Grenville and the Churchill structural provinces. Evidently (***Figure k32.2***), the Kenoran orogeny was a thermal metamorphic event that culminated some 350 million years after (!) the end of granite emplacements in the Superior structural province. ❑

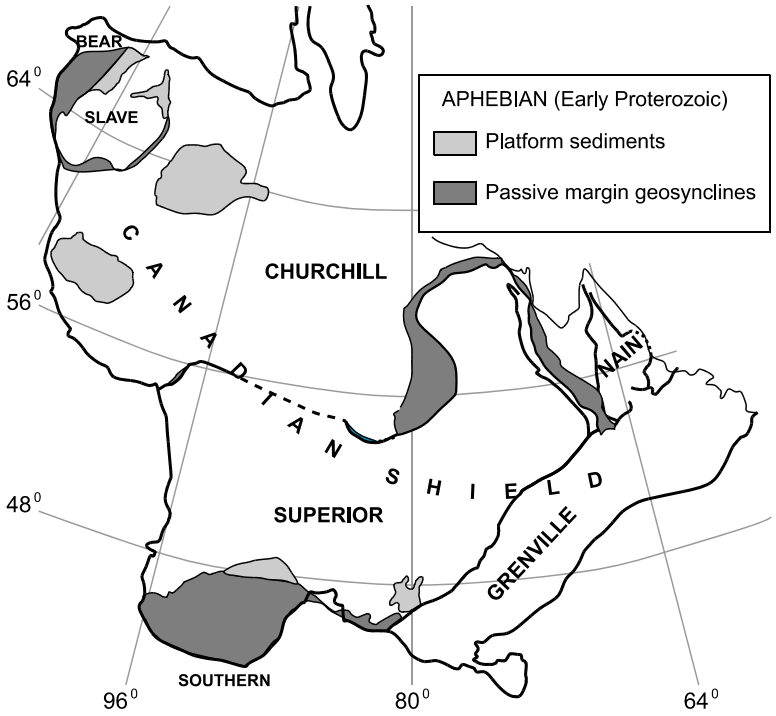

Figure k32.1 [5] Structural provinces of the North American Shield as named and known in the mid-1960s.

Figure k32.2 [6] Proterozoic time subdivisions for the Canadian Shield based on K-Ar radiometric evidence of major orogenies. Histograms (gray) showing numbers of mica K-Ar dates determined by analyses of micas from wide sampling of three structural provinces of the Canadian shield. Compared are zircon U-Pb dates of igneous crystallization, plotted as frequency distribution (black area and curve), for a wide sampling of North America and Europe.