k12 The Proterozoic Eon < 2 Gy duration >

... the great tragedy of science—the slaying of a beautiful hypothesis by an ugly fact. —Huxley.[1]

The youngest Precambrian sediments preserved in North America today, are those that accumulated on Laurentia during the "Eocambrian" or what the USGS has called *Precambrian-Z*, or what the GSC has called the *upper part of the Hadrynian*, or what the ISC has as the *Ediacaran Period* (541-~635 Ma) of the Neoproterozoic Era (541-1000 Ma) of the Proterozoic Eon (541-2500 Ma).

At its beginning, Laurentia was a continent that 760 Ma separated, with an encircling passive margin of >14,000 km, out of the interior of a fragmenting supercontinent named Rodinia (after the Russian word for *motherland*). Prior to then, the northwestern margin of Laurentia-to-be, from which East Antarctica-to-be and Australia-to-be were separating,[2] was a partially sea-flooded extensional foreland that accumulated (Beltian) sediments in fault controlled, slowly subsiding, basins. Its southern margin 800 Ma was joined by a wide terrain called the *Grenville* structural province. Earlier, between 800 and 1200 Ma, this margin had opened and interior to it an aulacogen accumulated Keweenawan sediments and basaltic volcanics. Evidently, Rodinia was in part breaking up and in part assembling during the time of its existence between 760 and 1000 Ma.

The Keweenawan and underlying Animikie formations were, during the first half of this century, the stratotypes for the recognition of and so for the correlation of Protozoic age Precambrian strata unconformable upon folded crystallines thought to be the fundamental complex that recorded the original cooling of a molten Earth (Kelvin's influence on geology was paramount at the time).

The Proterozoic Eon, which spans the time of accumulation of the Keweenawan series and the older Animikie group (***Figure k12.1***), is now known to be a duration of some two billion years.

Animikie strata accumulated between 1300 and 2400 Ma on protocontinents that existed prior to Rodinia. (These protocontinents survive, fragmented and agglomerated in continental shields, as structural provinces (*see* Topic *k29*) of Aphebian and Archean age.)

Named Precambrian time units, time-rock units, and orogenic events, are of local significance (***Figure k12.2***) and should not be regarded as more. This principle was not always appreciated. As J. A. Jacobs, R. D. Russell and J. Tuzo Wilson in *Physics and Geology,* 1959, wrote: [3]

> The concept of correlating rocks by type was carried even further. Thus the presence of gently folded red sandstones cut by diabase and basalt near the top of Precambrian sequences in several parts of the world has led to their correlation with similar rocks at Keweenawan Point on Lake Superior. They might as well be correlated with the Newark series of New Jersey, which is Triassic in age. There was no world-wide period for the formation of such rocks; rather, at the close of every orogeny there has been a tendency to form rocks of the Piedmont facies, which therefore in each area tend to lie at the top of the local column. This correlation of strata by lithology or rock-stratigraphic units might be possible even in the absence of fossils if the strata were continuous, but such is rarely the case over long distances for Precambrian rocks.

The paleogeography of the Precambrian world cannot be reliably reconstructed given the present state of geology, if ever. For example, whereas the assemblage Gondwana is recorded by the Pan-African orogeny between 530 and 800 Ma, there is no certainty that it formed separately from Rodinia or was a fragment broken *in toto* out of Rodinia.

In 1986, Kenneth A. Plumb writing for the Subcommission on Precambrian Stratigraphy recommended two perspectives, the one, operational, that there is an immediate need for a practical

and widely accepted scheme for subdivision of the Precambrian, the other, conceptual and fundamental, that the subdivision of time is a separate problem from the correlation of events and rock units.[4]

Implementing the first recommendation, the working compromise, in place of, say, the subdivision used by the GSC presently (***Figure k12.3***), is to use for the boundaries of the Proterozoic time divisions their world averaged radiometric dates: [5]

		Age of Boundry, Ma	
EON	*ERA*	*USGS (1983)*	*ICS (2005)*
Proterozoic	Late	570	542
	Middle	900	1000
	Early	1600	1600
Archean	Late	2500	2500
	Middle	3000	2800
	Early	3400	3200
		3800?	3600

However, the clarity that these dates imply is known to be not there when it comes to delineating locally, or even regionally, significant rock-stratigraphic boundaries that can aid prospecting. ❑

Figure k12.1 Names of time, and time-stratigraphic subdivisions of the Proterozoic Eon and orogenies originally used in the Great Lakes region and, prior to 1964, for the Canadian shield. The time subdivisions of the Proterozoic given in the right column (and adopted in the USA) were provisionally recommended in 1986 for world use by the Subcommission on Precambrian Stratigraphy.[3]

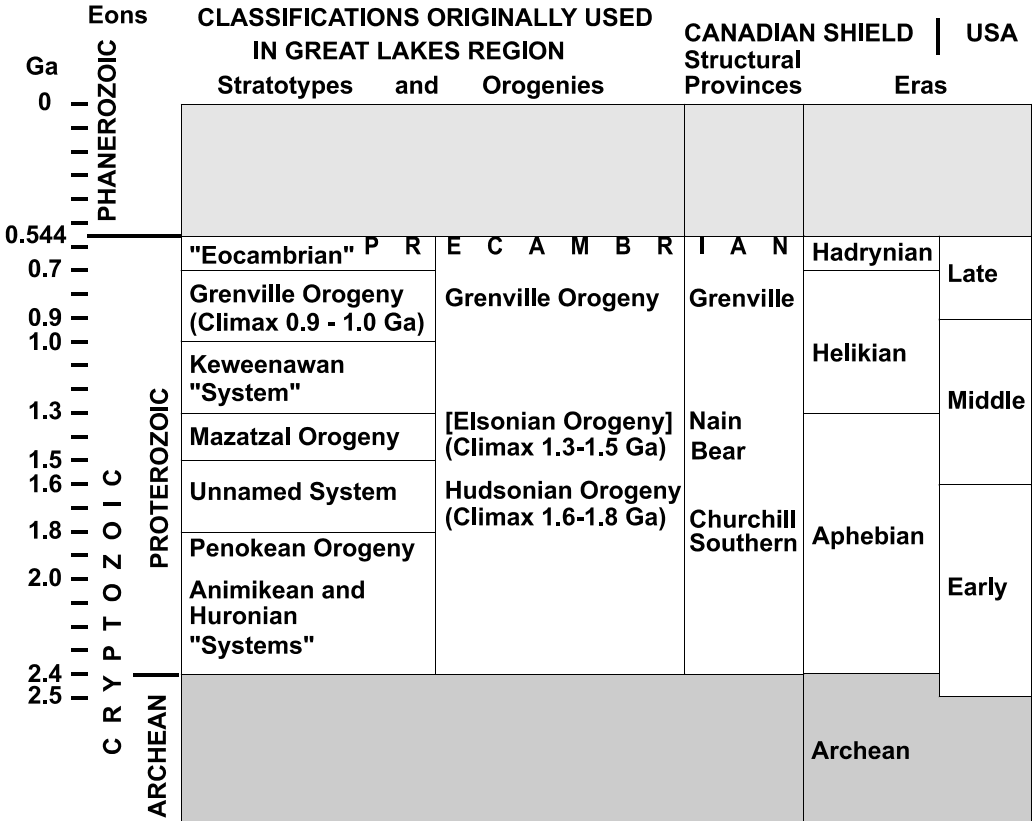

Figure k12.2 Presently used named subdivisions of Precambrian time

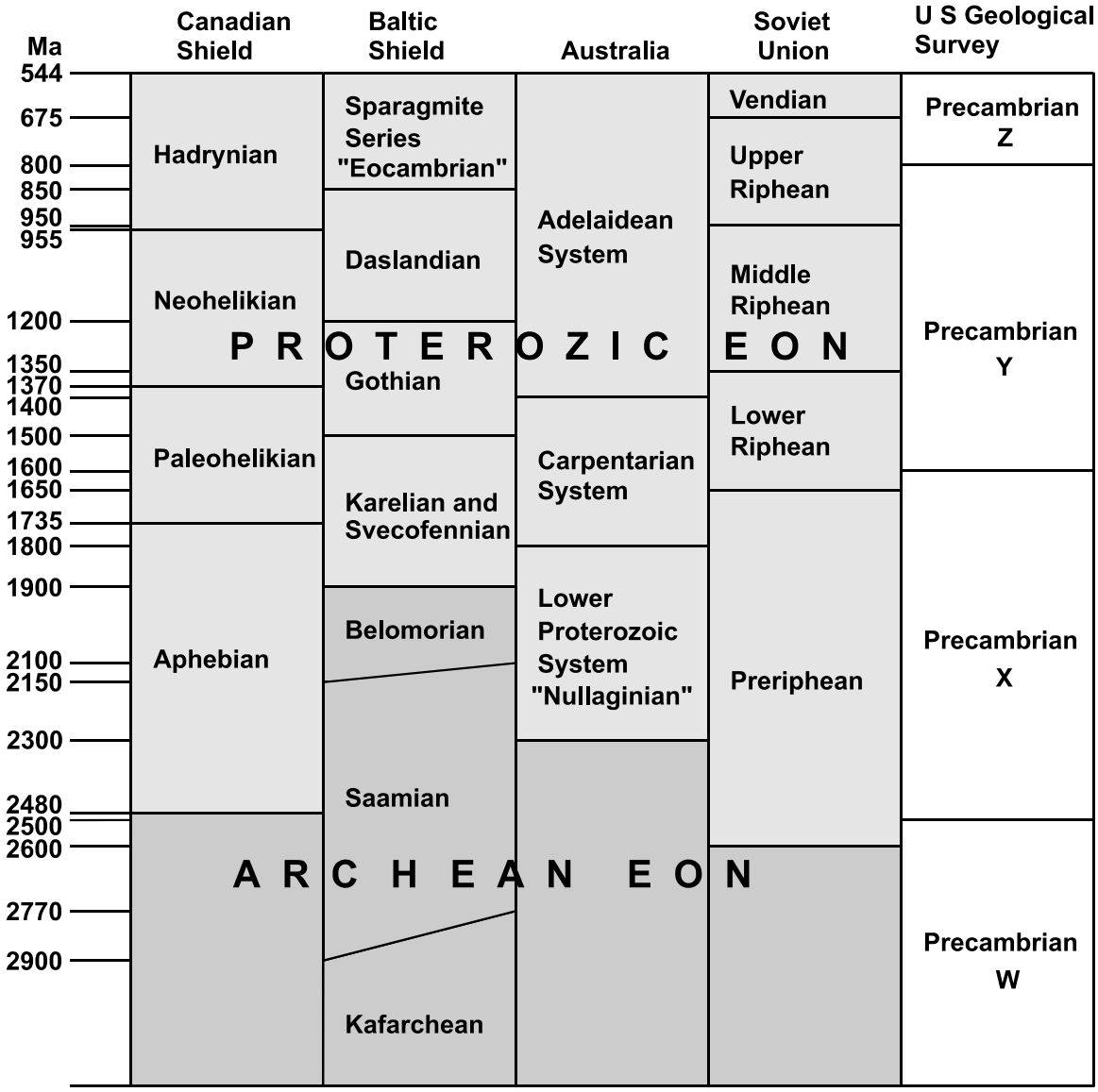

Figure k12.3 Named subdivisions of geologic time currently used by the GSC (Geological Survey of Canada)[6]