World Precambrian Stratigraphy Distribution and Tectonic Setting of Precambrian Crust

By

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Introduction

- The bulk of Earth's Precambrian crust is located in nine Precambrian cratons-large, subcircular to oblong, tectonically stable continental entities composed of Precambrian rocks of diverse types and ages, which dominate the main continents - Asia, Europe, Greenland, North America, South America, Africa, India, Australia and Antarctica.
- The nine Precambrian cratons, together with rare neighbouring island microcontinents, comprise both (1) exposed shields, also called craton, block, uplift, rise, belt, nucleus, ridge, etc.; and (2) buried (i.e. sub-Phanerozoic) basement and cover.
- Additional Precambrian crust lies in numerous median massifs (inliers), scattered within long, linear, pericratonic Phanerozoic mobile belts, and in certain peripheral and isolated oceanic environments.

OROGENIES AND TECTONIC CYCLES

- Precambrian cratons attained tectonic stability in successive stages corresponding to tectonic cycles, each marked by a culminating orogeny.
- Each cycle preferentially affected a particular part of the composite craton, commonly a linear fold belt or more irregular terrain.
- Cratonization was achieved in stages, the successively stabilized parts referred to as orogenic provinces or blocks.
- The final craton is a patchwork mosaic of structural provinces, each with characteristic age or limited range of ages, that has been assembled by processes collectively called 'continental accretion', inclusive of additions upon (epi), within (intra-), around (peri-) and under (sub-) the existing continental crust.
- Bear the imprint of three Archean (> 2.5 Ga) and three Proterozoic *(2.5-0.57* Ga) tectonic cycles.
- Cratons comprise an older Precambrian (> 1.8 Ga) basement, with varied younger Precambrian peri- and intra-cratonic accretions (fold belts) and more or less Precambrian platform cover.

Orogenies Continued:

- The role of plate-tectonics in Precambrian cratonization requires constant appraisal. Geological processes have changed greatly as Earth has progressively lost heat, and actualistic plate-tectonic models become progressive|y less applicable to successively older rocks. Thus the evidence for operation of modern plate-tectonic processes is strong in later Proterozoic (< 1.3 Ga) crust, but weak-to absent in Archean (> 2.5 Ga) crust. In this regard the possible role of other models, including voluminous magmatism, remains controversial and largely unexplored.

- Precambrian cratons of the world stand at different levels of understanding, depending on a variety of factors, including bedrock exposure, access, economic exploration incentives, population density and, especially, intensity, duration and caliber of scientific studies.
- These factors, together with the virtual absence of Precambrian index fossils, the immensity of Precambrian time, the comparative scarcity of the Precambrian sedimentary record and the complementary dominance of hitherto largely intractable gneissic terrains, compound the inherent Precambrian imprecision

Cathaysian and Siberian Craton

- ***Cathyesian Craton*** includes three component cratons~ Sino-Korean, Tarim and Yangtze---each characterized by restricted Precambrian exposure and correspondingly widespread buried basement. Additional pericratonic Precambrian crust lies in numerous median massifs enclosed in closely compressed Caledonian, Variscan and Tanshanian fold belts.
- ***Siberian Craton*** to the north comprises the Aldan (-Stanovoy) and Anabar shields, Olenek Uplift, four restricted peripheral Precambrian fold belts in the south and west, and extensive buried interior basement and platform cover.

East European (Russian Craton) and Greenland Precambrian Shield

- ***East European (Russian) Craton***, comprising the comparatively large **Baltic (Fennoscandian) Shield** and much smaller **Ukrainian Shield,** the slightly buried Voronezh Uplift and Volga-Kama Anteclise to the east, with intervening aulacogen-induced troughs, and the deeply buried interior basement including the Moscow (-Baltic) and Caspian syneclises. At least 10 Precambrian median massifs are contained in the Variscan-Hercynian fold belts including Armorican, Central, Bohemian, Vosges-Black Forest, Iberian and Uralian massifs. Substantial but presently ill-defined, buried Precambrian crust lies in the neighbouring West Arctic Shelf.

- **The *Greenland Precambrian Shield***, part of the North American Craton, occupies all of this Island continent but the East Greenland Caledonides and North Greenland Fold Belt, both of which have some Precambrian inliers. Exposed shield rock is effectively restricted to the narrow, ice-free coastlines.

North American Craton and Arabian Craton

- **The *North American Craton,*** less Greenland, includes (a) in the northern part, the unusually large Canadian Shield with buried extensions beneath the Hudson, Arctic, Interior and St Lawrence lowlands; (b) the comparatively small Wyoming Uplift to the west; and (c) substantial buried basement in southcentral (midcontinent) USA.

- Guiana, Central Brazil and Atlantic shields, with buried basement beneath (a) the intervening Amazon, Parnaiba, and Paranfi basins; (b) the Sub- Andean Foredeep to the west; and (c) the Atlantic margin deposits to the east. The adjoining, south tapering, Phanerozoic-dominated Patagonian Craton to the south is integrated here for convenience.

- **The *African (-Arabian) Craton*** occupies all of the continent with the exception of the restricted Cape, Mauritanide and Atlas fold belts, located respectively at the south, northwest and north margins. This unusually large craton is conveniently divided by an orthogonal system of late Precambrian (Pan-African) mobile belts, into five parts: **(a)** Kalahari (southern); (b) Congo (equatorial); (c) West African (northwestern); (d) East Saharan (north-central) cratons; and (e) Arabian-Nubian (northeastern) Shield. Two large central subsidence basins~Taoudeni and Congo--are located in the West African and Congo cratons respectively. The southerly Kalahari Craton is largely obscured in the northwest by the Kalahari desert. The rifted Madagascar and Seychelle Islands are included in the African Craton.

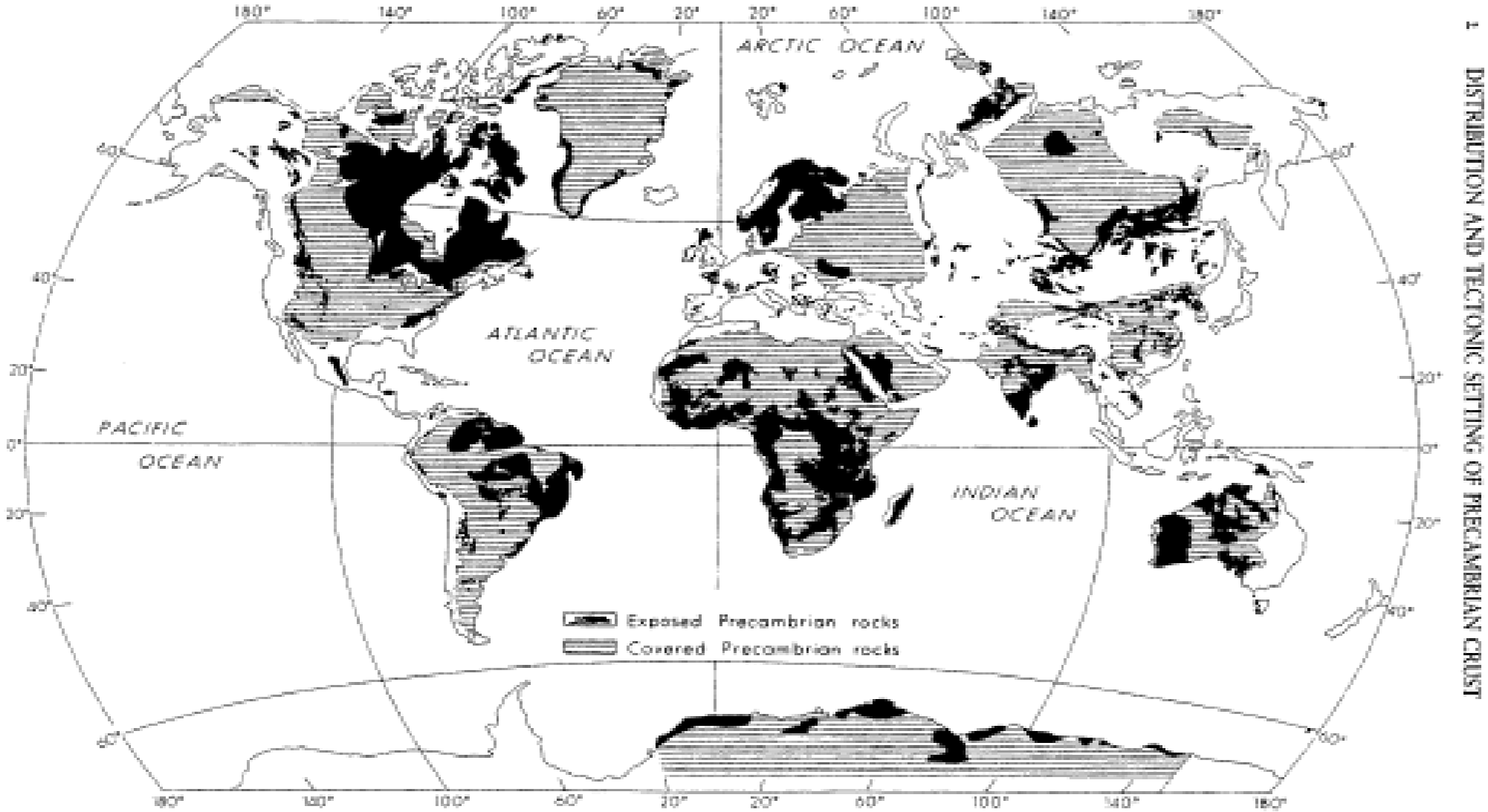
Australian and Antarctic Cratons

- **The *Australian Craton*** underlies all of the continent and adjoining shelf except for the Tasman Fold Belt in the east. The craton extends northward beneath the Arafura Sea to incorporate a south-central embayment in Papua-New Guinea. The craton is conveniently divided by the Central Australian Mobile Belt network into the North Australian, West Australian (Yilgarn and Pilbara blocks), Gawler (-Nullarbor) and Curnamona cratons and Northeast orogens, each with specific subdivisions.

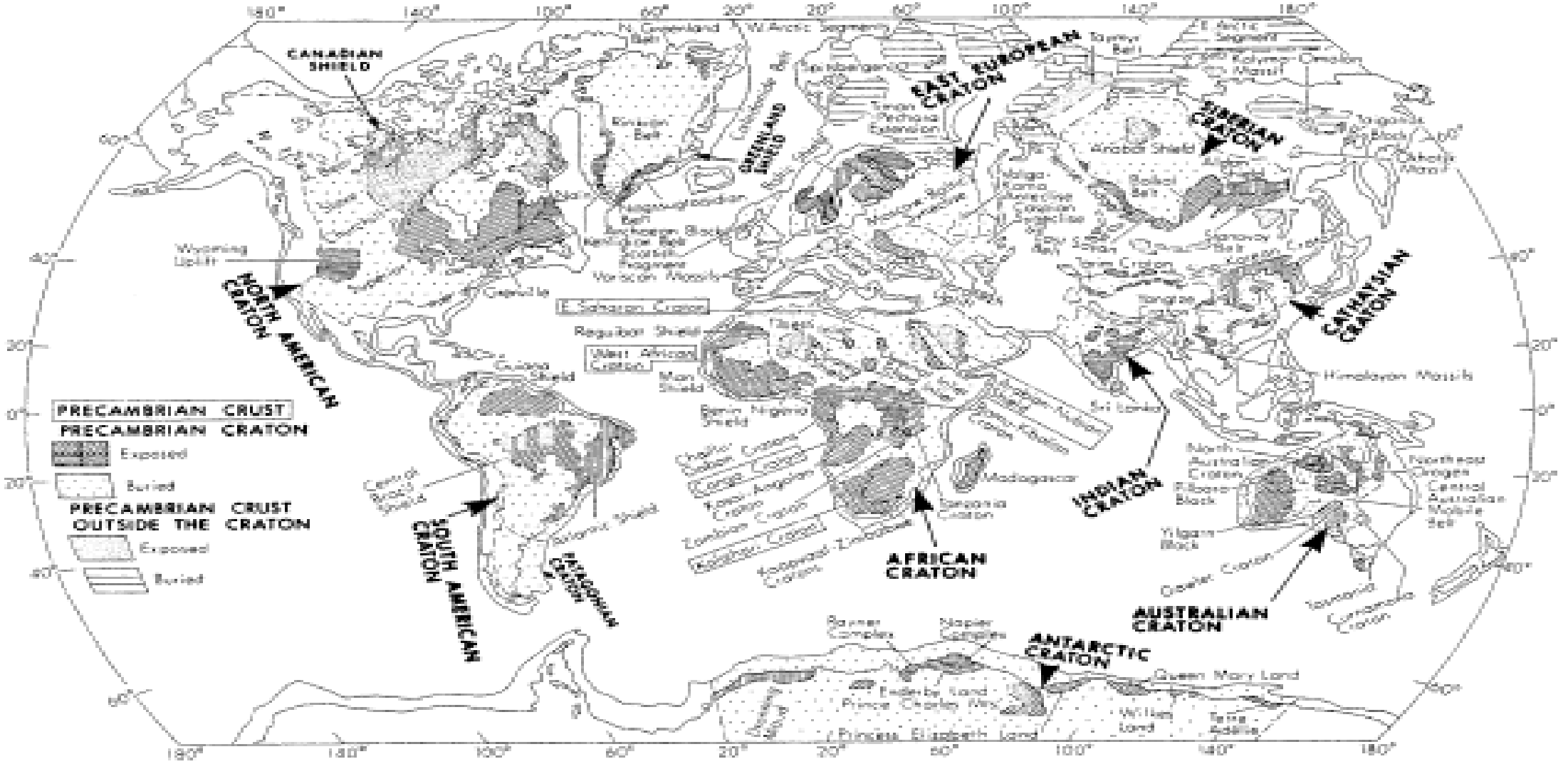
- **The *Antarctic Craton*** is dominated by the East Antarctic Metamorphic Shield, which adjoins the Transantarctic Mountains (Fold Belt) which itself contains numerous Precambrian inliers. The great bulk of the Precambrian Craton lies beneath the continental ice sheet, with exposures mainly restricted to the coastline including those in Dronning Maud Land and Enderby Land, Prince Charles Mountains, Princess Elizabeth, Queen Mary and Wilkes lands and Terre Adelie.

Indian Craton

- **The *Indian Craton*** with Sri Lanka includes exposed Precambrian terrains in the southern (Dravidian), eastern (Eastern Ghats), northeastern (Chotanagpur-Singhbhum) and northwestern (Aravalli) blocks, with substantial buried extensions beneath the west-central Deccan Traps and the unusually extensive Ganges-Indus flood plain which encroaches northward on the Precambrian inlier-charged Himalayan Fold Belt, products of extensive Cenozoic subduction-collision events.



Global Precambrian sketch-map showing the distribution of exposed and buried (sub- Phanerozoic) Precambrian crust within the conventionally defined continents. Data plotted on National Geographic Society base-map 'The World', National Geographic Magazine (Washington. December (1981)



Global Precambrian sketch-map showing the distribution of Precambrian cratons including exposed shields (cratons, fold-belts, blocks, etc.) and buried (sub-Phanerozoic) platforms, together with Precambrian median massifs (inliers) within the continents as bounded by the continental slopes.