(Edited by A. V. Sankaran)

Oldest emergent continental crust

Even though oldest known Archaean rocks date back to 3.96 billion years, it is not clear when the ancient crust actually emerged out of the primeval oceans that had covered the entire Earth, i.e. when the first continental crust formed and remained stable. This rarity of the early crust (Figure 1) among the continents is attributed by some to the fact that they accumulated slowly over millions of years, while some others believe that most of such crusts that rose above the sea plunged subsequently back into the mantle. However, the search for these early fragments of crust has recently resulted in the discovery of an undisturbed greenstone succession in the Pilbara Craton, Western Australia[1]. This strata lying beneath the rocks of the Warawoona Group revealed typical angular unconformity, indicating that they remained stable long enough to be exposed to weathering by wind and water to produce erosion surfaces. Isotopic Pb–U dating of zircon crystals from these rocks indicated their age to be 3467.6 ± 3.7 million years, half-billion years older than the oldest evidence of continental basement hitherto known (all the greenstone supra-continental volcanic and sedimentary succession deposited over eroded continental basements indicate ages below 3.0 billion years[2]). The findings have only strengthened the strongly held view that substantial volumes of continental crust existed during the first billion years of Earth's history, though most of them were recycled into the mantle[3]. This discovery promises to provide a much sought after material – weathered detrital remnants or palaeosols which are strongly believed to lie below the unconformity. These would be very valuable as they could provide useful data about the presence of free oxygen and carbon dioxide in early atmosphere, about the greenhouse effect, and silicate weathering. More importantly, they may provide further information about the beginnings of life on our planet, especially since the oldest fossil cells that were found more than a decade back were from the very Warrawoona Group lying above this unconformity[4].

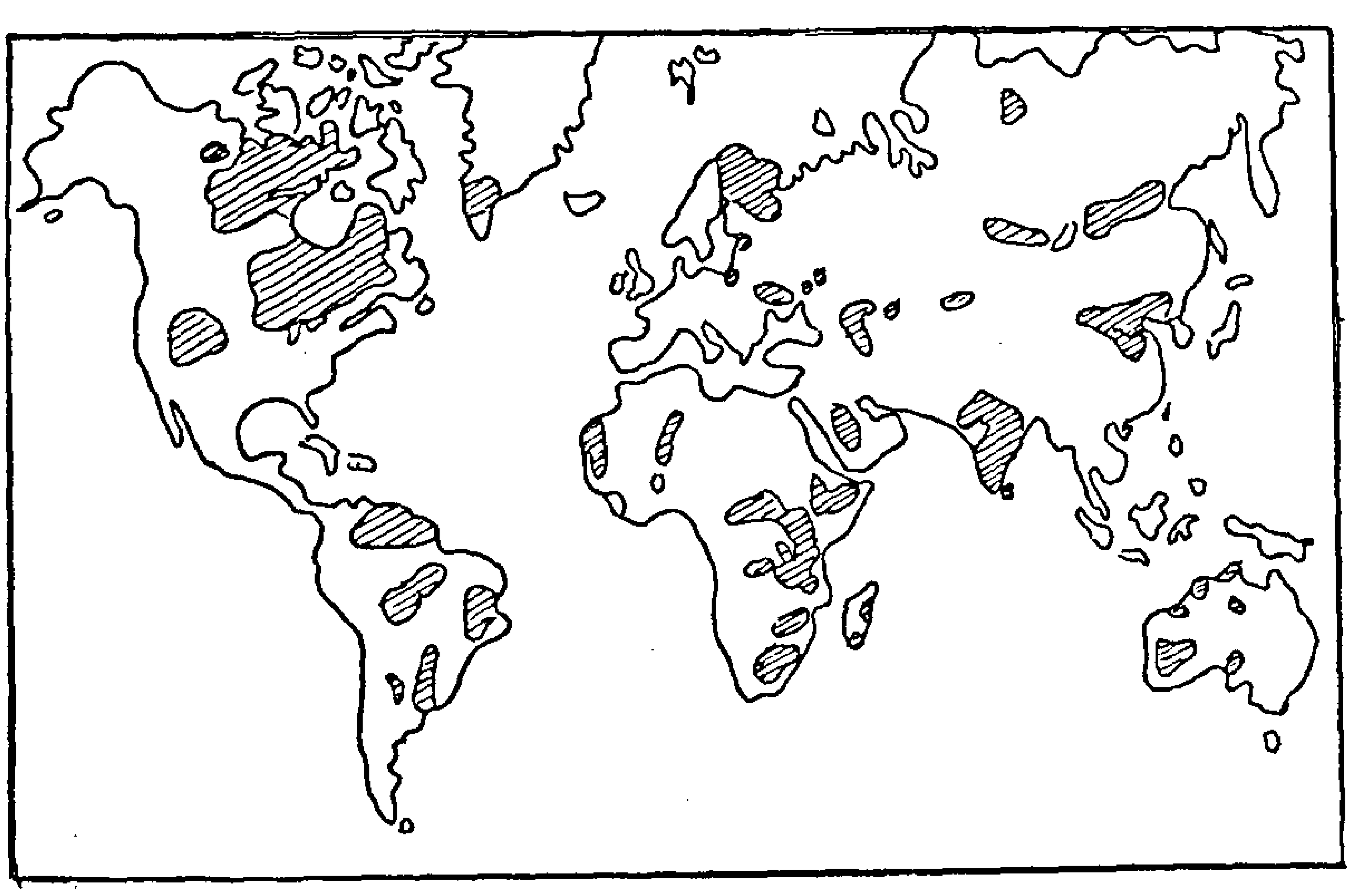

Figure 1. World map showing areas (striped) more than 2.5 billion years old.

1. Roger Buick *et al., Nature*, 1995, **375**, 574–577.
2. Bickle M. J., Nesbit, E. G., and Martin A. J., *J. Geol.*, 1994, **102**, 121–138.
3. Bowring S. A. and Housh T., *Science*, 1995, **269**, 1535–1540.
4. Paul F. Hoffman, *Nature*, 1995, **375**, 537–538.

Earthquake precursors

Viable early warning systems for natural calamities such as cyclones and volcanic eruptions are available, but earthquakes have eluded scientific attempts of forecasting. In the recent past three independent groups have published results of their systematic studies on some of the early though (not fully established) indefinite pointers that often precede earthquakes. Two seismologists, Pierre F. Ihmle and Thomas H. Jordan have noted[1] in 20 cases investigated by them indirect evidences of large energy releases called 'slow earthquakes' (low frequency seismic anomalies) minutes prior to the major event. Their observations are from 19 oceanic events and only one continental event from southern Sudan (Intracontinental transform fault in the East African Rift System). These are important clues mostly obtained from seismic events over the oceanic crust, but to be considered as reliable precursors for predicting earthquakes over the land, systematic monitoring of such early signals in quake-prone regions of the continents must be undertaken.

Sudden chemical changes in subsurface waters have been observed by two teams of Japanese scientists[2], days before the devastating 7.2 magnitude earthquake of Kobe, Japan, in January 1995. The concentrations of dissolved chloride and sulphate ions in the groundwater below

Kobe started increasing steadily five months before the actual earthquake and peaked more than a month after the event. Similarly, concentrations of radon in groundwater increased some four-fold several months before and shot up to ten times just nine days before the January event[3]. Such co-seismic changes were observed by researchers of Kyoto University also during the 7–8 magnitude events that occurred in 1994. Hydrogeochemical changes of this nature have been noticed earlier in some of the Asian earthquakes also but the data have been mostly of a qualitative nature and no systematic monitoring or quantitative measurements of such precursors were attempted to be useful for early predictions.

Changes in the electromagnetic field (successfully used for prediction originally by Greek physicist Panayioks Varostos), and emission of high frequency radiowaves have been noted in earthquake-prone areas. Monitoring of these phenomena had enabled prediction of earthquakes in southern California (January 1994) and Kobe in Japan (January 1995) (ref. 4).

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3. Igarashi G., Saeki, S., Takahata, N., Sumikawa, K., Tasaka, S., Sasabi, Y., Takahashi, M. and Sano, Y., *Science*, 1995, **269**, 60–61.
4. Proc. Annual Meeting of Am. Geophys. Union, California, 1995.

Herbivorous crocodile fossil

Chinese geologists, surveying for petroleum some three decades ago, came across a 120-million-year-old skeleton with unusual features, in the lower Cretaceous of Huei Province of central China, and baffled by the uncommon features of its build, tentatively identified it as a peculiar animal. Recently, the fossil was resurrected from the shelves of Toronto Museum and re-examined[1]. It has now been identified as belonging to crocodile family and has been named *Chimaerasuchus paradoxus*. The skeleton consisting of snout, lower jaw, shoulder girdle, 15 vertebrae, forelegs, hand, pelvis and thigh bones provided a very good reconstruction of the animal – about 3 to 3.5 feet long with forward-pointing nostrils (unlike the normal carnivorous ones with up-pointed nostrils). What was, however, surprising was its multicuspid molar teeth which strongly indicated that the crocodile was herbivorous. Quite unlike the sharp conical teeth of carnivorous crocodiles, *Chimaerasuchus* had relatively flat teeth with distinct cutting edge at the back – features specialized for a fibrous plant diet, and comparable to some of the mammals and mammal-like reptiles.

1. Xiao-Chun, Wu, Hans-dieter, Sues and Ailing, Sun, *Nature*, 1995, **376**, 678.

A. V. Sankaran lives at 10, P&T Colony, I Cross, II Block, R. T. Nagar, Bangalore 560 032, India.