Ediacaran low-latitude paleoclimate was cool with a chance of icebergs

GREGORY J. RETALLACK

Department of Geological Sciences, University of Oregon, Eugene, Oregon, 97403-1272: gregr@uoregon.edu

The Cryogenian Period includes the largest known global glaciations, with Elatina Formation tillites at 6.5 ± 2.2º paleolatitude [1], but the succeeding Ediacaran Period also had cool paleoclimate in the stratotype sections of South Australia. The GSSP marking the base of the Ediaracan does not correspond to a dramatic global warming, because there are persistent periglacial paleosols within the Nuccaleena Formation [2]. Periglacial sand-wedge paleosols and intertidal facies in the Elatina Formation at Hallett Cove, at a stratigraphic level correlative with tillites to the north, are evidence for frigid but unglaciated coastal plains and an equatorial seaway during the Cryogenian, rather than a complete global freezing. The succeeding Ediacaran was no tropical paradise despite a low paleolatitude of 15 ± 3.6º for the Bunyeroo Formation [3]. At least three successive glaciations are revealed by dropped pebbles in the lower Bunyeroo Formation [4], rapid sea level fall in the Wonoka Formation palaeocanyons (exacerbated by local salt tectonics [5], and dropped pebbles in the Billy Springs Formation [6]. Radiometric dating of the three glaciations elsewhere gives Gaskiers glaciation *ca*. 582 Ma [7], Fauquier glaciation *ca*. 571 Ma [8] and local interpolation gives Billy Springs glaciation at *ca*. 560 Ma. Interglacial paleosols of the Bunyeroo and Wonoka Formations and the Bonney Sandstone and Ediacara Member of the Rawnsley Quartzite [9], include gypsic and calcic profiles of arid climates, not unusual for low latitudes. Application of a paleothermometer for modern lichen tundra [10] to Ediacaran paleosols yields mean annual temperatures of 8.9 ± 0.4 ºC to 10.9 ± 0.4 ºC. Such low temperatures and icebergs as a source of dropped pebbles in marine rocks at low latitudes are evidence that the Ediacaran was another unusually cold period in Earth history.

[1] Schmidt & Williams (1995) *Earth Planet Sci Lett*. **134**, 107-124. [2] Retallack (2011) *J. Geol. Soc. Lond*. **168**, 1-19. [3] Schmidt & Williams (1996) *Earth Planet Sci Lett*. **144**, 347-357. [4] Gostin *et al* (2010) *Austral. J. Earth Sci*. **57**, 859-869. [5] Kernen *et al* (2012) *Geol. Soc. Lond. Spec. Publ*. **363**, 85-105. [6] Jenkins (2011) Geol. Soc. Lond. Mem. **36**, 693-699 [7] van Kranendonk *et al* (2008) In Ogg *et al*. *Concise Geologic Time Scale* [8] Hebert *et al Precambrian Res*. **182**, 402-414 [9] Retallack (2013) *Nature* **493**, 89-92. [10] Óskarsson *et al* (2009) *Geoderma* **189-190**, 635-651.