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From Archaean oceans to Late Proterozoic cratons: The origin, evolution and preservation of the continental material on earth

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The earth's outermost rocky shell consists of two major components: continents and oceans. Oceans are continuously generated along spreading centres and also continuously destroyed by subduction along deep-sea trenches. Because of their ephemeral nature they have an average age of 0.1 Ga. The oceanic crust has an average density of about 2.9 g/cc. It covers nearly 60% of the planet's surface, but makes up only 20% of its crust and a vanishingly small 0.00099% of its total mass. No part of the oceanic crust has any permanence: even its slightly more buoyant parts (oceanic plateaux) are ultimately subducted unless protected within a continental embayment (e.g. the Pre-Caspian Depression). The only exception to this rule may be the Tarim Block, which may be a trapped oceanic plateau of Proterozoic age now functioning as a craton. Whether the Black and the South Caspian oceans will have a similar destiny cannot now be told, although the latter is now being subducted along the Apsheron sill.
Continents by contrast seem permanent parts of the crust: Their average density is 2.85g/cc and mean age is 2.0 Ga and in places the oldest rocks are dated to be older than 3.8 Ga. Some individual zircons recovered from continents in a few places are older than 4 Ga; some have yielded evidence for wet mantle melting and reworked continental crust as far back as 4,370 million years ago. In fact, there is now 176Hf/177Hf evidence consistent with the view that a volume of continental crust close to the present one may have formed by 4.4. to 4.5. Ga, but then entirely mixed back into the mantle by the beginning of the Archaean, both by a permobile subduction regime and heavy meteorite bombardment-controlled mixing! The present rock record on continents began to be kept since about 3.8 Ga ago, i.e. since the end of the heavy meteorite bombardment. The preserved Archaean tectonic record shows a great resemblance to the Turkic-type orogens of the Phanerozoic and probably formed in a similar way. When large areas of Turkic-type orogens are reshortened by subsequent collisions they re-thickened and their mantle parts, largely now devoid of basalt-making components and therefore lighter and stiffer formed what Stille had termed "full-cratons". When similar events occurred in Meso- and Neoproterozoic times they too generated cratons, but not "full" ones. Stille termed them "quasi-cratons", because they still allowed German-otype deformations as are well-known from the basement of the United States and European Russia. Whether cratons are generated in the Phanerozoic are now a contentious issue, but places such as Tibet and the Zagros seem, contrary to conventional wisdom, still to hang onto their mantle lithospheres suggesting they are on their way to become Proterozoic-like cratons. Caledonian and Hercynian Europe today behave much like a quasi-craton.