critical inflection point in geological history, marking a co-evolution of organisms and paleoclimates that flourished by mutations. Appropriate external conditions made the early life further radiate, and the second and third phases of the Cambrian explosion were unveiled. They are represented by the Meishucun small shelly fossils (SSFs) on the western margin, and the Chengjiang biota and the contemporaneous Qingjiang biota on the western and northern margins of the Yangtze Block, respectively. Such manifestations indicate that the Cambrian explosion in the Yangtze Block was most likely related to the Neo- proterozoic subduction and continental arcs, which could provide sufficient nutrients for the later early life radiation.

Subduction erosion at Pacific-type convergent margins

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Pacific-type convergent margins (PCM) or orogenic belts form over subduction zones, where the oceanic lithosphere is submerged under intra-oceanic arcs or active continental margins. PCMs are very important geological entities because they are major sites of juvenile crust formation on the Earth, but also places of strong crust destruction via subduction erosion (Clift and Vanucchi, 2004). The most challengeable issue of the reconstruction of fossil magmatic arcs is the probable disappearance of arc igneous formations from geological records due to subduction erosion. The main agents of subduction erosion are horst-graben topography of subducting oceanic plate, orthogonal subduction of intra-oceanic arcs and ridges and accretion of oceanic rises (seamounts) (von Huene and Ranero, 2003). There are two contrast types of Pacific-type convergent margins – accreting and eroding (Scholl and von Huene, 2007). The accreting margins form accretionary complexes and grow oceanward. The eroding margins are characterized by the shortening distance between the arc and trench and subsequent subduction erosion of accretionary wedge, fore-arc prism and volcanic arc.

The first evidence for the tectonic erosion at Pacific-type convergent margins came from seismic reflection profiles made across the Tonga and Nankai trenches. The modern Pacific is surrounded by 75% of eroding convergent margins and 25% of accreting margins (Scholl and von Huene, 2007). The fast-subducting Pacific plate provides high-rate subduction erosion of the hanging walls of the western Pacific margins. Evidence for the subduction erosion comes from the proximity of coeval accretionary and supra-subduction complexes, the presence of supra-subduction igneous rocks as blocks in exhumed serpentinite mélange, trench jumping landward and related, magmatic lulls and the disappearance of U–Pb zircon age peaks in younger clastic rocks. For example, the Costa Rica consuming boundary in South America witnesses high rates of sediment destruction (Vanucchi et al., 2016), and the Cretaceous Shimanto accretionary prism in Japan is spatially adjacent to the coeval granitoids of the Ryoke belt suggesting that older accreted units were eroded (Safonova et al., 2015).

The present Western Pacific is the most probable actualistic analogue of the Paleo-Asian Ocean (PAO), which suturing formed the Phanerozoic Central Asian Orogenic Belt (CAOB) (Safonova et al., 2011). Accordingly, we suggest that the processes of subduction erosion were probably active at the PAO active margins. Evidence for this comes from the Chatkal-Atbashi arc in the middle Kyrgyz Tianshan, the Itmurundy and Tekturmas zones of central Kazakhstan, Ulaanbaatar accretionary complex (AC) in Mongolia and Char zone in eastern Kazakhstan, all in the western CAOB. The Chatkal-Atbashi complex includes coeval and spatially adjacent Early Devonian arc granitoids, ophiolites and accretionary units. In the Itmurundy and Tekturmas zones, the middle-late Cambrian igneous rocks of supra-subduction origin have been diagnosed only as blocks in serpentinite mélange. In addition, in the Itmurundy and Tekturmas zones, the accreted oceanic units are located very close to the coeval supra-subduction complexes. The Itmurundy, Tekturmas and Char zones host thick greywacke units of mafic to andesitic composition, which detrital zircons those greywackes show unimodal U-Pb age curves, disappeared older peaks in younger sediments and positive epsilon Hf values. There are nil arc magmatic formations in the Ulaanbaatar AC, but the graywacke sandstones therein show unimodal distributions of U-Pb detrital zircon ages and positive values of epsilon Nd (whole-rock) and Hf (in zircon) (Savinskiy et al., 2022). All these facts suggest that that that the Cambrian magmatic arc that once existed in the PAO was eroded (Safonova and Perfilova, 2023). Therefore, the processes of subduction erosion in the western PAO were similar to those in the modern Circum-Pacific, for example, over the Guatemala-Costa Rica-Chile (eastern Pacific), Tonga (SW Pacific) and Nankai-Japan (western Pacific) subduction zones (von Huene and Ranero, 2003).

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Concatenation of biogeochemical processes and mineralization in the Archean Oceans

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The Archean greenstone belts comprising the most diverse rock types on the Earth's surface are unparalleled archives of the planet's evolution including the origin of the proto-oceans and their physico-chemical properties, evidence of plate tectonic processes, formation of oceanic crust and its role in the development of continental crust with vast mineral deposits. Although it is established that the tectono-magmatic processes operative on the primordial Earth played a pivotal role in shaping the planet's hydrosphere, atmosphere and biosphere, thus moulding the planet habitable for complex life forms, the processes governing the interactions between these spheres for mineralization remain unclear. The Dharwar Craton of southern peninsular India is a natural geological museum with well-preserved volcano-sedimentary assemblages present in the greenstone belts along with TTG-granitoid sequences and intruded dyke activity, documenting a billion-year crust formation history that is contemporaneous with the evolving mantle heterogeneity, ocean oxygenation, origin and evolution of