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Review on spheroidal weathering and associated fractures

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We review spheroidal weathering/ "corestone shell systems" and genesis of associated fractures that are usually sub-circular/sub-lenticular in shape. Intact individual cores of unweathered rock, sometimes twinned and/or pitted, 0.02 to 2 m in diameter consisting of several zones of micro-crack densities, which transform temporally from ellipsoid to sphere, are left behind. Such cores are surrounded by a shell of weathered rinds/rings. Sometimes granular structureless rock materials are found in place of solid cores. Towards the core, fractures are usually more circular. Spheroidal weathering has been noticed most commonly in basalts where curved fractures are more close-spaced, and also in granites with fewer and widely spaced fractures, dolerites, limestones, mudstones and sandstones. Tectonic and atectonic joints/fractures, columnar joints in some cases and shear zones augment chemical weathering by providing preferred flow path of (acidic) fluids. Water absorption, chemical decay and brush fire affects the outermost part of rocks. However, these processes and change in meteoric water shower/frost action cannot be the unique mechanisms of spheroidal weathering since this phenomenon has also been reported from shallow depth. In the later case, pneumatolysis (effect of hot fluids from depths to start the weathering process) might be the trigger. Whether chemical alteration of rocks can produce dilation in rock has been questioned, although dilation has been ascertained from orientation pattern of deformed crystals in vesicles in the altered rim of some spheroids. Volume change and subsequent spheroidal weathering might be possible also by unloading/exhumation of sedimentary- and metamorphic rocks, but this does not possibly apply to Deccan trap basalts in western India. Alternate rings in spheroidal weathering could be enriched in Si, Al, K and Zr in certain zones and in Ca and Fe in other. Concentration of Fe, Ca, Zr, Y, Rb, Al, Si and K may vary from one colour zone into the other. This chemical constraint along with colour contrasts observed in some spheroidally weathered igneous rocks possibly indicate that the Liesegang hypothesis of weathering might hold true even in natural conditions where alternate Fe-rich and Fe-poor layers may form around the core. Spheroids of the Deccan trap basalts in and around Mumbai are certainly not tectonic inclusions nor are centers of cooling of lava. Mathematical models of spheroidal weathering mechanism that simulated hyperbola like weathered surfaces have not yet significantly included chemical constraints such as the the Liesegang hypothesis.