

## Why do *fossil* bones and teeth exist?

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Given the readily observable instability of bone in surface environments, the abundance of very ancient fossil bones and teeth is quite remarkable. Although both modern and fossil bones and teeth are composed of the calcium phosphate mineral apatite, the fossil material is enriched in such elements as fluoride. Comparison of Raman spectral trends in natural primary fluoride-rich apatite in shark teeth, secondarily fluoridated modern teeth, and fossil teeth supports a solubility-driven model of fossilization. During interaction with groundwater of even minor fluoride concentration, fossilizing bones and teeth undergo partial dissolution (of original bioapatite) followed by new precipitation (of essentially *end-member* fluorapatite). The lower solubility of fluorapatite than original bioapatite both induces the dissolution-reprecipitation process (cf. [1]) and preserves the bones and teeth from further disintegration. The driving force to initiate fossilization is chemical disequilibrium between bioapatite and the water in contact with it; the completion of fossilization depends on the maintenance of disequilibrium. The initial requirement is a slow rate of introduction of water that is under-saturated with respect to bioapatite, but that contains an ion (Z) whose activity, together with those of the now-dissolved calcium and phosphate, exceeds saturation with respect to Z-apatite. The latter precipitates epitaxially on the existing apatite. Continued delivery of new aliquots of such water, aided by the enhancement of bone's porosity and permeability as its 50 volume% of collagen is degraded and consumed by microbes [2], ensures the progress of dissolution-reprecipitation. The fact that, in the examples here, end-member fluorapatite precipitates rather than the equilibrium composition of OH-F-Cl-apatite is another example of disequilibrium processes at work. Depending on the timing and ambient chemistry, this fluoridation-preservation process may preserve important isotopic and trace-element signatures of the original sample.

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[1] Putnis (2002) *Mineral. Mag.* **66**, 689-708. [2] Trueman *et al.* (2004) *J. Archaeol. Sci.* **31**, 721-739.

## Runoff water pollution in India

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Urban runoff water pollution is one of the leading causes of water pollution and becomes worse with population growth and urbanization [1]. The runoff water pollution is one of the major diffuse pollution sources for depleting water qualities [2]. The aim of this work is to describe the runoff water quality during the rainy season (i. e. May – September, 2008) in the most industrialized region: Raipur region (Chhattisgarh state, India).

Two cities: Raipur (21°24'N and 81°63'E) and Korba (22° 21' N and 82° 40' E) of central India was selected for the proposed study due to running of several industries by collecting the water samples into 5-l cleaned polyethylene container following the established method. The mean (n = 10) pH value of the runoff water at three sites: Raipur urban (RU), Raipur industrial (RI) and Korba industrial (KI) is 6.9±0.4, 6.9±0.3 and 6.8±0.3, respectively. The annual volume weighted mean value (n=10) of, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup>, Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>, Mn, Fe, Cu, Zn, Pb and Hg in the RU site is 120±144, 297±192, 113±63, 12±4, 84±138, 67±87, 42±41, 484±557, 271±122, 995±1187, 190±73, 675±205, 226±96 and 8±3 mg l<sup>-1</sup>, respectively. In industrial site, higher loading of the pollutants is observed. The variations, correlation, enrichment and removal of the pollutants are discussed.

[1] Burton & Pitt (2002) *Stormwater Effects Handbook*. A tool for Watershed managers, scientists and engineers. Lewis Publishers, CRC Press, Boca Raton (FL), USA. [2] Tosić *et al.* (2008) *Runoff Water Quality*, Landuse and Environmental Impacts, Springer