

Identification of geochemical facies and processes of fluoride enrichment in ground water of fracture granitic aquifer of Chimakurthy watershed, Southern India

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The genesis of fluoride rich ground water is a combination of complex processes involving many dynamic factors with variant magnitude. Aquifer chemistry, mineralogical makeup of host rock, pressure-temperature conditions of solute play a deciding role in ground water attaining a saturated status with respect to fluoride assimilation which again is under constant modifications in space and time. Understanding the multi-variant hydrochemical processes of high fluoride aquatic enrichment in a fractured, semi-confined aquifer system could give more clarity to this much debated subject. Fluoride content is very high in this closed Pre-cambrian granitic water shed reaching as high as 11ppm with a mean of 1.70ppm. Limited seasonal variation in fluoride content is noticed but it varies widely in space as higher content of fluoride in ground water is noticed at the contact zones of granite gneiss and Norite gabbro which occurs as an enclave amidst leucocratic, feldspar rich granites. The fluoride do not exhibit distinct relation with any of the analyzed elements including Ca. Trace element chemistry is also unique in this area as Sr and Zn are very high. Rock chemistry, in which fluoride content varies between 202 and 612ppm indicates that weathering processes, water-rock interaction and fluoride rich aquifer material together with favourable semi-arid climate could be responsible for high fluoride content in ground water of this water shed.

Structure model of synthetic amorphous calcium carbonate

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Formation and subsequent transformation of amorphous calcium carbonate (ACC) are widely recognized as integral steps of biomineralization in certain calcifying invertebrates, and this strategy has been exploited for bio-inspired synthesis. An incomplete understanding of structure in ACC has posed challenges for identifying the mechanisms by which additives control ACC stabilization and influence crystallization behavior. Adopting a model approach, we explore a combination of methods for determining structure in ACC over a wide range of length scales. Whereas several different varieties of ACC are known from biogenic and synthetic sources, our initial work focuses on synthetic, hydrated ACC. Pair distribution functions obtained using synchrotron X-ray total scattering data reveal the presence of medium-range order (up to 15 Å) in biogenic and synthetic ACC. Results of reverse Monte Carlo refinement of the total scattering data reveal that the ACC consists of a porous calcium-rich framework that supports interconnected channels containing water and carbonate molecules. The existence of a previously unrecognized nanometer-scale channel network suggests mechanisms of how additives can be accommodated within the structure and provide temporary stabilization, as well as influence the crystallization process. Moreover, while lacking long-range order, the calcium-rich framework in ACC contains similar Ca packing density to that present in calcite, aragonite and vaterite, yielding clues of how the amorphous material converts into the different crystalline forms. The new structure model is found to be consistent with Ca EXAFS and NMR data, and provides a new starting point for examining interactions of additive molecules with ACC structure and their structural role in controlling stabilization and crystallization. This method should also find application to other varieties of ACC.