

The Barents Ecogeochemistry Project – Ecogeochemical Mapping of 1,500,000 km² in NE-Europe

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Scientists from Russia, Finland and Norway have jointly carried out a geochemical research and survey project in NW-Russia, Finland and NE-Norway. An important aim of the Barents project was to define the anthropogenic influence in relation to the natural variations of geochemical baseline over a large area containing both several world's largest industrial emitters and Europe's most pristine wilderness areas.

Terrestrial moss, the upper organic soil layer, the soil C-horizon and stream water samples were collected in 2000-2001 from 1085 sites in Russia and 288 sites in Finland.

Both total and aqua regia extractable element concentrations were determined from <2 mm fraction of minerogenic samples. Total element concentrations were measured in the plant and organic soil samples. Concentrations of more than 50 elements were determined from the samples.

The maps showing the distribution of 48 elements were shown in the Atlas. The geochemical patterns of minerogenic C-horizon are strongly controlled by element distribution in the bedrock. Some new metallogenic provinces were found in the area. Stream water data are mainly controlled by geological formations and structures both for major and trace elements. Anthropogenic activity is well reflected by anomalies in moss and organic soil layer near major industrial centres. Since the project area covers different bioclimatic zones from arctic tundra to subboreal forest, respective latitude dependence is visible on many elements distribution for moss and the organic soil layer.

Parallel to multimedia sampling and analysis, a qualitative visual estimate of the state of the ecosystem was performed for each studied site. Although this area is the most pristine in Europe, only 20% of the studied sites had no visual signs of human impact.

The replacement of calcium carbonate by hydroxyapatite

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The replacement of calcium carbonate by apatite is an important process in the growth of diagenetic apatite and also in biomimetic materials chemistry where apatite-replaced coral is being developed as a bone implant material. In the latter case the material properties depend on being able to pseudomorph the fine-structure of the coral. We have investigated the mechanism and the kinetics of the replacement of aragonite by apatite using the cuttlebone of *Sepia officinalis*, commonly known as the cuttlefish. The cuttlebone has an open chamber-like architecture with plate-like pillars (~5 microns thick) supporting parallel thin sheets, constructed from aragonite in association with an organic framework. Our samples, collected from various beaches in NSW Australia, have been thoroughly sun-dried and bleached. Scanning electron microscopy was used to characterise the morphology of the cuttlebone and aragonite was verified by X-ray powder diffraction. The amount of remaining organic component was determined after acid-dissolution.

Experiments were carried out using cut pieces of the cuttlebone sealed in autoclaves with (NH₄)₂HPO₄ solutions of varying concentration over a range of temperatures up to 170°C. The aragonite was completely converted to hydroxyapatite which was verified by X-ray powder diffraction and IR spectroscopy. Scanning electron microscopy showed that the fine-structure of the cuttlefish bone was maintained after the replacement process. The process of replacement is described in terms of a coupled dissolution-precipitation mechanism.

To determine the activation energy of the replacement mechanism, hydrothermal experiments were carried out over a range of lower temperatures to partially replace the aragonite, and the quantities of each phase determined by Rietveld analysis of powder X-ray diffraction patterns.

Atomic Force Microscopy was used to study the reaction of organic and inorganic calcium carbonate surfaces with (NH₄)₂HPO₄ solutions *in situ* in a fluid cell at room temperature to attempt to directly observe the dissolution and and reprecipitation process.