Calcitification of the last interglacial coral reefs in the Gulf of Aqaba - phreatic freshwater activity in the currently hyperarid region

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Fossil coral reefs provide geological records of late Quaternary sea level changes, tectonic movements and paleoclimate. Most studies on fossil reefs were done on pristine corals that preserve the original aragonite composition and texture. Yet, many fossil corals are affected by various degrees of diagenesis, e.g. recrystallization of aragonite to calcite due to interaction of the aragonitic coral with meteoric waters in either the vadose or phreatic zones. A surprising example for extensive coral's calcitification is provided by the uplifted late Pleistocene reef terraces along the Gulf of Aqaba (GOA), a region that is currently one of the most hyperarid climatic zones on Earth. U-Th dating of the calcitified corals from the City of Aqaba indicates that freshwater–coral interaction occurred shortly after the formation of the reefs during the last interglacial (~ 125 ka BP). It appears that coastal fresh-groundwater aquifers were common in the northern GOA during the last interglacial. Similar processes could have caused the massive calcitification of coral reefs in the elevated Pleistocene terraces along southern Sinai Peninsula. The climatic mechanism that dictated the transition from hyperarid to wetter conditions in the GOA during past interglacials is not obvious, but might be related to northward shifts in the ITCZ and the monsoon system that caused the wet episodes in the Sahel-Sahara deserts.

Modern thermofilic cyanobacterial mats: Geochemical features

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This study consideres cyanobacterial communities of the Barguzin Valley (Baikal Rift Zone) hot springs and a complex research of minerals forming and redistribution of elements, C isotopes and ^{226}Ra, ^{228}Ra between the organic and mineral parts of microbial mats. Hot springs are alkaline hydrotherms. The Alla type waters (Alla, Kuchiger, Umkhei, Seya) are SO_4-HCO_3-Na solutions with high HS^- and low Rn (4 eman) content. The Garga, Uro and Gusikha spring waters are HCO_3-SO_4-Na and characterized by the absence of HS^- in the solution and Rn content is of 30-10 eman. In all hot springs solutions alkaline, alkaline-earth (Li, Rb, Sr, Cs, Ba) and anionogenic elements (Si (30-45 ppm), Ge, Mo, W) prevail.

SiO_2 precipitation proceeds as the result of the thermal solution evaporation from the microbial mat surface and of the silicic acid gel coagulation. The adhesion of SiO_2 flakes upon cyanobacteria filaments results in forming of covers. Rhombohedral and psimatic calcite crystals are precipitated in a microbial communities which develop in the waters with Ca concentration more than 10 mg/l (Alla, Garga, Gusikha). Calcite which is being formed in a microbial community is enriched with $\delta^{13}C$ relatively to the organic matter.

The distribution of K, Mn, Ni, Cu, Zn, Fe between the organic and mineral parts of cyanobacterial mats is regular; Ca, Rb, Sr are almost totally related with the mineral part, while Ga, Ge and Br are accumulated in organic substance. Ge (up to 600 ppm) and Ra isotopes (up to 7000 Bk/kg) are concentrated in the cyanobacterial communities, which develop in sulphideless, Rn-bearing springs.

There is an opportunity examined of a complex use of the cyanobacterial mat geochemical characteristics as biosignatures in terms of the Garga spring carbonate deposits.

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