Geophysical Research Abstracts
Vol. 19, EGU2017-17934, 2017
EGU General Assembly 2017

87Sr/86Sr sources of late Miocene-early Pliocene water bodies in northern Israel

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During the late Miocene to the early Pliocene periods a thick sequence of sedimentary rocks accumulated in the Lower Galilee (LG) and the Jordan Valley (JV) basins in northern Israel. The sequence lies between the Lower Basalt/Hordos Fm. and the Cover Basalt and comprises: the Umm Sabune Fm. and the Clay Series Unit; the Bira Fm., the Gesher Fm., the Fejjas Tuff and a unit of conglomerates paleosols and pyroclastic rocks. Here we focus on the Bira and Gesher Formations of Tortonian (∼10 – 7 Ma) and Messinian-Zanclean (∼7-5 Ma) ages, respectively. The Bira Fm. consists mainly of limestones, dolostones and marls in the LG and also of evaporites (gypsum and halite) in the JV. The Gesher Fm. comprises limestones, dolostones and marls in both the LG and JV basins. The depositional environments of these formations were lacustrine and palustrine, but the location of the sedimentary basins at the margins of the Mediterranean Sea made them sensitive to marine influence at their western side and during sporadic ingressions.
87Sr/86Sr ratios of soluble (carbonate-evaporite) fraction and insoluble (non-carbonate) residues of the Bira and Gesher carbonate samples were analyzed and are are used to constrain the sources of waters filling the lakes and that of fine-detritus and reconstruct the paleohydrological conditions in the watershed. The soluble fractions of most of the Bira Fm. carbonates (∼ 0.7075) reflect the contribution of different types of continental water sources and marine waters to the Bira and Gesher Fms. lakes. In the upper part of the formation (∼8-7 Ma) the 87Sr/86Sr ratios rise (to ∼0.7085) and could reflect mixture of continental waters with Tortonian sea-water. The soluble fractions of the sediments from the Gesher Fm. show higher 87Sr/86Sr ratios (∼ 0.7085-0.7087) that cannot be attributed to seawater contribution since the Mediterranean Sea retreated to the west. These ratios are explained by contribution of Sr from waters draining mountain soils. The latter are evolved by pedogenesis of settled desert dust that was blown from the Sahara-desert.
The “insoluble residues” show an overall temporal increase in the 87Sr/86Sr ratios rising from “basaltic values” of ∼ 0.704 at the lower part of the Bira Fm. to “granitic-crustal” values of ∼ 0.711 at the upper part of the Bira Fm. and throughout Gesher Fm. This change is interpreted as reflecting the changing contribution of detritus to the lacustrine and palustrine environments of the Bira and Gesher Fms. In between ∼ 10-7 Ma most of the detritus was derived from local, mainly basaltic sources while at ∼7.5 -5.33 Ma, fine detritus was mobilized from the evolving Sahara-desert to the lakes watershed. The contribution of the Sahara dusts was enhanced during the Messinian Salinity Crisis (∼5.97-5.33 Ma.).