Geophysical Research Abstracts
Vol. 13, EGU2011-11185, 2011
EGU General Assembly 2011

Tectonic uplift at the Gibraltar Arc and the Mediterranean salt pan. Towards a mechanistic model for the Messinian Salinity Crisis

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The mixing of Mediterranean waters with the world's oceans became reduced during the Messinian Salinity Crisis (MSC, 5.96 to 5.33 million years ago), causing widespread salt precipitation and a $\sim$1.5 km water drawdown by evaporation. While much progress has been achieved in understanding the associated water and salt balance, the timing and processes involved in the closure of the Mediterranean remain controversial. Competition between tectonic uplift at the connecting corridors in the Gibraltar Arc and global sea level changes has been suggested as the main control, but the difference in time scale between these processes is difficult to reconcile with the long initial phase of shallow but persistent connection, responsible for the first evaporitic phase.
Combining simple mathematical approaches to water-flow erosion, salt precipitation, and climatic processes, shows that gateway erosion by the incoming water allows a long-term connection of a few tens of meters between Atlantic and Mediterranean by reaching a dynamic equilibrium with tectonic uplift. The cyclicity observed in outcrops of early salt deposits may be the result of harmonic coupling between Mediterranean evaporation and strait erosion, predicting oscillations of the Mediterranean water level of up to 500 m, and cycles of salt precipitation of 2000-5000 kyr. Required uplift rates are consistent with uplifted marine sediments and with a proposed lithospheric slab detachment at the Gibraltar Arc. The consistency will be checked between the erosion model required for this dynamic equilibrium and the depth of the gorges carved by major rivers at the margins of the Mediterranean Sea during desiccation.