Geophysical Research Abstracts
Vol. 17, EGU2015-15675, 2015
EGU General Assembly 2015

Fluid transport processes in the passive margins of the Eastern Mediterranean

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We analyse and produce a synoptic model of the different styles of fluid transport occurring in the various passive margin settings in the Eastern Mediterranean. The common tectonic-stratigraphic setting is dominated, from the Mesozoic, by the interaction of the Tethyan platforms with Cenozoic to recent, mainly clastic, deposits interacting with the ubiquitous thick late Miocene (Messinian) evaporitic sediments. This created different specific modes of fluid-lithology coupling behaviours, and generated an extraordinary suite of seismically resolvable fluid flow phenomena, including mud volcanoes, pockmarks, dissolution/collapse structures, chimneys and pipes. We integrate this evidence with the analysis of the regional pressure/temperature gradient, and with published hydrocarbon generation models, to propose a regional synthesis of all fluid transport processes in a specific basinal context. We place the fluid flow evidence observed in the Eastern Mediterranean in the framework of the three main fluid flow settings, which are typically defined in sedimentary basins, in terms of depth:

1) A thermobaric fluid regime, where fluid transport is limited and convection can be the dominant transport mechanism,

2) A thermogenic regime, where fluids supplied by hydrocarbon generation can migrate by hydraulic fracturing and advection (along open faults/conduits), by matrix flow and in the longer term, by diffusion processes,

3) A shallow compactional regime, where the fluids are generated by sediment dewatering and shallow diagenesis, and the main transport mechanism is characterised by vertical fluid flow, either through advection and hydrofracturing along faults, or matrix flow.

In the Eastern Mediterranean passive margins, this depth-related subdivision needs to be modified in order to accommodate the influence of the laterally and vertically extensive evaporitic series, which acts as a regional aquitard/aquiclude to water or a seal to hydrocarbon flow. The presence of this tabular halite-dominated layer modifies the thermal and pressure regimes, density, rate of loading and concentration gradients. Where the evaporites are subject to halokinesis, additional processes such as thermohaline convection should be considered. Furthermore, where gravitational tectonics has either utilised or considerably deformed the plastic salt layer, pathways are enhanced developing more fault-controlled and vertical fluid flow.