



## **Fluids circulation during the Miocene rifting of the Penedès half-graben, NE Iberian Peninsula**

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The Penedès half-graben, located in the north-western part of the Mediterranean, is a NE–SW oriented basin generated during the Miocene rifting. This graben is bounded to the northwest by the SE-dipping Vallès-Penedès fault, which places the Mesozoic rocks in contact with the Miocene basin-fill. The basin is filled with an up to 4 km thick succession of sediments divided into three lithostratigraphic units. From base to top: (1) a lower continental complex, (2) a continental to marine complex and (3) an upper continental complex. These units are covered by Pliocene deposits which onlap a Messinian regional erosive surface.

The structural features within the Penedès half-graben allow defining three deformational phases during the Miocene rifting. The first, during the syn-rift, two successive stages of NE-SW normal faults were formed. The second, during the early post-rift, one stage of NE-SW normal faults and one minor compression phase with a dextral directional developed. The third, during the late post-rift, two successive stages of N-S trending extensional fractures (faults and joints) and one minor compression with a sinistral component developed.

The fractures related to the syn-rift stage acted as conduits for meteoric fluids both, in the phreatic and in the vadose zone. During the early post-rift, Fe<sup>2+</sup>-rich fluids precipitated oxides along the NE-SW fault planes. The dextral directional faults served as conduits for meteoric fluids which reequilibrated totally the marine Miocene host rocks under the phreatic environment. The late post-rift stage was characterized by marine fluids upflowing through the N-S fractures, probably derived from the Miocene marine interval, which mixed with meteoric fluids producing dolomitization. The second set of N-S fractures served as conduits for meteoric fluids characterised by  $\delta^{13}\text{C}$ -depleted soil-derived CO<sub>2</sub> attributed to precipitation in the vadose zone. The change from phreatic to vadose meteoric environment and the prevailing of these vadose conditions is interpreted as the falling-down of the meteoric water table related to a generalized sea level fall in the Mediterranean area during the Messinian and/or with the uplift of the basin.