Geophysical Research Abstracts, Vol. 9, 06101, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06101

Failure modes and fault development in the Miocene carbonate grainstones, Lettomanoppello area, Maiella Mt. (Italy)

F. Agosta, M. Alessandrini and E. Tondi

Dipartimento di Scienze della Terra, Università di Camerino, Via Gentile III da Varano, 62032 Camerino, MC, ITALY

We documented the failure modes and fault development in the Lower Miocene-Tortonian Bolognano Formation, Maiella Mountain (central Italy). After detailed analysis of the structural elements present within the carbonate grainstones, and of their crosscutting and abutting relationships, we recognized four different structural assemblages: (i) overburden, the oldest assemblage, which includes discontinuous, bed-parallel Pressure Solution seams (PS); (ii) pre-tilting thrusting assemblage, which consists of two orthogonal sets of bed-perpendicular PS that formed during early thrusting, when the beds were still flat; (iii) syn-tilting thrusting assemblage, which includes two main sets of low-angle-to-bedding PS that developed in response to flexural slip of the carbonate beds; (iv) normal faulting, the youngest assemblage, which consists of both tail PS and tail joints of the sheared, pre-existing structural elements under a vertical loading.

Focusing on the normal faults present in the Bolognano Formation, which contain hydrocarbons in the form of tar, in the more massive beds they developed by both pressure solution- and opening mode-based mechanisms. The former was the most prominent mechanism during the earliest stages of faulting, which were characterized by both normal and left-lateral slip. During these stages, low-angle-to-bedding, tail PS formed in the contractional quadrants of the sheared, bed-perpendicular and bed-oblique PS. The coalescence of these tail PS with the pre-existing, bed-perpendicular and oblique elements defined small pods of fragmented rocks within the individual carbonate beds. The resulting architecture of the incipient normal faults was therefore made up of short, discontinuous slip surfaces that bounded pods of isolated fragmented

rocks. The offset of these faults was on the order of a few centimeters.

Sub-vertical, tail joints formed subsequently in the extensional quadrants of the sheared bed-perpendicular, oblique, and tail PS elements, and also in the extensional quadrants and in correspondence of irregularities of the throughgoing slip surfaces. The orientation of these tails joints show that the latest stages of normal faulting were characterized by a normal sense of slip. The throughgoing slip surfaces coalesced together the structural elements present in contiguous beds, and brecciated the carbonate rocks. The architecture of the resulting normal fault zones, characterized by offsets up to a few tens of meters, is thus comprised of a meter-thick fault core of fault rocks, brecciated carbonates, and major slip surfaces, and tens of meters-thick damage zones of fractured and fragmented carbonates. Within the fossil-rich beds of the Bolognano Formation, the normal faults developed primarily by shear-banding, whereas in the marl-rich beds due to a pressure solution-based mechanism. The results of our work provides useful insights to better understand the structural control exerted by fractures and faults on the flow of hydrocarbons in carbonate grainstones.