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Tectono-sedimentary evolution and new sections across the western Gran Sasso d'Italia (Central Apennines)

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During Jurassic-Cretaceous times, the area of the central Apennines was part of a large, Bahamian-type carbonate platform–basin system, whereby the area of the Gran Sasso was situated between the carbonate platform of Latium and the Abruzzi in the west and the deep basinal area of Marche-Umbria to the east. This transitional area experienced 1. Early Jurassic rifting of the Adriatic margin, leading to the opening of the Ligurian branch of Tethys; 2. prolonged thermal subsidence of the carbonate-platform slope and base-of-slope in the Jurassic–Cretaceous; 3. decollement along Triassic evaporites, thrusting and folding during the Neogene formation of the arc of Gran Sasso and 4. post-nappe normal faulting persisting to this date.

Mapping of the western part of the E–W-trending ridge of the Gran Sasso d'Italia has yielded the following results:

1 – The early Jurassic rifting event led to the segmentation of the platform slope into structural highs (Corno Grande and Acqua San Franco) and basins (Pizzo d'Intermesoli, M. Corvo) as suggested by the pronounced differences in thickness of the early–middle Liassic syn-rift sediments (Corniola Formation). Whereas the Acqua San Franco structural high in the west was buried during the Toarcian, the Corno Grande high in the east persisted throughout Mesozoic times at least into the early Tertiary. The longevity and possible tectonic reactivation of the submarine topography, inherited from early Liassic rifting, persisted way into Jurassic–Middle Miocene as suggested by the pronounced differences in thickness of the Jurassic base-of-slope (Corno Piccolo Formation) and Oligocene to Miocene distal ramp sediments, and sequences punctuated by stratigraphic gaps on the highs.

2 – During the Tertiary orogeny of the Apennines, the inherited Mesozoic structures evolved into N-S trending transfer zones between the individual thrusts and folds over- and underthrusting the more external Laga unit. The axis of the frontal anticline and the related thrust of Gran Sasso plunge westward with a parallel decrease in shortening. The tip line of the blind thrust related to the frontal fault-propagation fold becomes deeper and more internal moving westward, according to a gradual transfer of shortening toward the adjacent recess. The E-W trending arm of the Gran Sasso arc experienced a component of left-lateral transpression as expected from the NE-ward propagation of the central Apennines accretionary wedge. The propagation of the arc occurred during deposition of the Messinian Laga Flysch Formation as shown by the growth structures in the latter.

3 – The backlimb of the frontal fault-propagation fold indicates that the entire structure has been tilted after its development. We speculate that this has been generated by a deeper ramp of a backthrust, forming a triangle zone affecting the entire E-W trending Gran Sasso range. This would explain the about 15 km long, regionally diffuse monocline of the Gran Sasso range toward the foreland.

4 – Normal faults cut across the previously tilted internal limb, as shown by the cut-off angle of the faults relative to bedding; Most of them show morphologic evidence of present-day activity, but only part of the displacement observed is due to the Pleistocene-Holocene extension because of the poly-phase role of the main fault systems. The Tre Selle fault is clearly linked to the Assergi Fault by the Campo Imperatore Fault that has transtensive characteristics and an en-échélon orientation, functioning as a link between the two former fault systems. According to surficial fault rupture height, the overall normal fault system could generate earthquakes of Mw>6.5.