Mechanics of Orogenic Zones

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The fabric and tectonic/structure evolution of orogens is dependant upon a complex mix of factors in the seven basic types; continent-continent collision, continent-arc collision, contraction of para-rifts, Andean style progeny, New Zealand style progeny, progeny at locking bends of transforms, and looping orocline collision just prior to terminal oceanic closure. These factors include:

- The petrographic layering, crustal thickness; and thermal age of the colliding/contracting margins, which together determine the vertical rheological zonation which, in turn, determines the flexural wavelength at lithospheric and upper crustal scales and the thermo-mechanical behaviour of the orogenic lithosphere. Foreland flexural strength is critical in determining the slope up which thrust sheets are pushed, the integrated compressive strength and potential decollement horizons of the orogenic lithosphere depends upon crustal thickness, petrography and geothermal gradient. In the India/Eurasia collision zone, India has an old thick strong lithosphere except at its northern edge because of Triassic rifting, whereas Tibet, especially in the north, is made up of arcs and accretionary prism assemblages; hence Tibet and the Himalayas take up the shortening. Thermally young lithospheric colliding and shortening edges take up more shortening than thermally old ones and also have more potential decollement horizons. The collision of intra oceanic arcs generates short-lived progeny (~10 My) and nappe piles rapidly heated by the shallow asthenosphere of the arc.
- The amount and rate of plate convergence determine, respectively, the width of an orogenic belt and its style. Fast convergence causes high strain rates and more brittle behaviour to greater depths.
- The obliquity of plate convergence determines whether orthogonal shortening, oblique shortening or partitioned transpression occurs.
- Climate may he an important factor in determining orogenic style. The New Zealand Alps are an intracontinental dextral transpression steady- state orogen with denudation equalling rock uplift at about 100 $mm.a^{-1}$. If precipitation rates were lower, rock uplift would exceed denudation, vertical stresses would he greater and both deep and shallow gravity-driven tectonics would be more important.
- Late orogenic extensional collapse causes rapid exhumation of core complexes with massively-strained retrograded high pressure rocks with horizontal fabrics. Whether or not collapse occurs is largely dependant upon the petrography and water content of the lower crust. Lower crustal convection and bulk lateral flow may be important in determining tectonic style and fabric.

Polyphase deformation may be generated in at least ten ways.

Plio-Pleistocene sedimentary facies and tectonics of the central-east Sicily

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In the Plio-Pleistocene age the Sicilian area has been characterised by the presence of two emerged areas: the Madonie–Nebrodi–Peloritani sector and the Hyblean plateau. The former corresponds to the orogenic Miocene front of the Apenine–Maghrebian thrust belt; the latter is the correlative term of the northern part of the pelagian foreland (Lentini et al. 1990). Around the Messinian Caltanissetta basin, between the aforementioned sectors, the marine sedimentation has always had foredeep characteristic with more terrigenous facies in the central area opposed to the carbonatic deposit found in the East and Southeast areas.

The correspondent litostratigraphical sequences generally show a lower part formed by clays, silt and muds that pass up into either coastal carbonate sands or silicoclastics. Upon their age and some slight unconformity, these sequences were referred to different sedimentary events. The age of pelitic arenaceus sequence found out in the Centuripe–Enna–Caltanissetta area is included between the Lower and Middle Pliocene age, whereas in the Piazza Armerina Mazzarino--Barrafranca area it is included between the Upper Pliocene and Lower Pleistocene. Between S. Michele di Ganzaria and Gela and along the western Hyblean margin, the two facies are of Lower Pleistocene age.

The facies tectonic control (Roda 1968, Butler et al. 1995), is mainly marked by their inner discontinuity. The age of the first and lower of them is Lower Pliocene, and it is in linked with the Trubi Fm. and Marne di Enna Fm. The second, which is to be dated to the early Upper Pliocene, is referred to the contact between the Geracello Fm. and Capodarso Fm. The age of third one is referred to lower Pleistocene and it regards the younger part of Pleistocenic deposit overlying the different terms of the Gela nappe and the Hybleian substrate. Minor unconformities were found out inside the Capodarso Fm. and in the younger terms.

The tectonic interference has frequently affected the sedimentary structure. It affects several levels and it has both extensional and compressive style with folds and faults of various types.

In a preliminary way and subordinately in the light of the acquired knowledge, the stratigraphic and sedimentological characters show that can not be excluded that the evolution of the aforementioned facies is related mainly to the younger and south-eastern part of the Sicilian thrust belt dynamic translation besides to the glacio-eustasy (Gela nappe: Ogniben 1969, Lentini et al. 1990). It began during the lower Pliocene and it ended in the lower Pleistocene generating a piggy-back depositionary basin (Ben Avram et al. 1990, Catalano et al. 1993). This translation affected the sedimentation generating the facies progradation from North toward south and toward east with facies repetitions and partial overlaps.

The area, during the upper Pleistocene as well as nowadays, is affected by an elevated uplifting phase and for this reason, Pleistocene coastal sediments are placed at 850 metres above the sea level.

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Cenozoic-Pleistocene alpine signatures in the southern Upper Rhine Graben

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The NNE-SSW trending Upper Rhine Graben (URG) initiated in the Late Eocene as part of the West European rift system. Subsidence curves record rapid subsidence during the Oligocene and early Miocene accompanied by uplift of the rift shoulders (Vosges and Black Forest). This period of E–W extension in the foreland coincided with the peak of Alpine collision to the south. 3D models of the southern Rhine Graben, constructed in the gOcad geometric modelling package and constrained by an extensive database of boreholes and seismic reflection lines as well as published data, are used to reconstruct the Cenozoic evolution of the southern URG. Initial results in the Dannemarie Basin, which forms the SW limit of the URG, indicates that subsidence increased northward during the Rupelian, but toward the south during the Chattian. We propose that this change in asymmetry was due to the influence of alpine flexure.

During the Aquitanian the southern URG was uplifted along with its rift shoulders while subsi-