Did Upper Eocene short-lived corallinacean-foraminiferal carbonates form in mesotrophic paleoenvironments along the Alpine convergent margin?

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The actualist paradigm of restricting large forms of hyaline larger benthic foraminifera (LBF) to oligotrophic environments is challenged by their rock forming occurrence in short-lived, Upper Eocene corallinacean carbonates of the external, sedimentary nappes of the Alps (Helvetic, Chaînes Subalpines and Lombardian Southern Alps).

Abundant large forms of orthophragminids, nummulitids and other rotaliids occur with over 20 species in grey limestones recently attributed by us to SBZ 19 and 20 (Priabonian, Sanetsch Formation) in several Helvetic and N-Helvetic nappes of Western Switzerland and the Haute Savoie, France. In this deepening upwards formation, the upper lithofacies (Pierredar Limestone Member) are largely dominated by coralline rhodophyceans: melobesian and peyssonneliacean crusts, rhodoliths and abundant bioclasts of geniculate rhodophytes. The matrix of the bioclastic limestones contains variable amounts of fine-grained lithics, such as quartz, feldspars, mica and some charcoal fragments. The darkest lithologies give off a smell of kerogen, contain <10 μm framboidal pyrite, as well as larger pyrite aggregates, frequent in the matrix, indicating dysoxic conditions in bottom waters and/or beneath the sediment surface. In sections weakly affected by alpine burial diagenesis, LBF reveal a pristine, intrinsic cathodoluminescence unlike recrystallized specimens from shallow water environments. Hence, there is evidence of displacement of LBF, exhumed from shallower, well-oxygenated domains into the dysoxic depositional sites. On the other hand, even the lowest, shallower, cross-bedded parts of the sections show oxidized pyrite, charcoal fragments, and abundant quartzo-feldspathic material.

Modern coralline rhodophyceans occupy a wide range of habitats from tropical to temperate zones. They dominate in the “marginal reefs” or “turbid reefs” recently described from many mesophotic and mesotrophic shelfal areas of the Atlantic and elsewhere, alas, without mention of LBF.

Prevailing mesotrophic conditions during formation of the Priabonian carbonates are suggested by the occurrence of extensive pavements of the large oyster *Pycnodonte gigantica*, common irregular echinoids, bryozoans, serpulids and solitary corals, while hermatypic scleractinian corals are rare and restricted to genera, at present-day tolerant to mesotrophic and/or mesophotic, soft sediment conditions, such as *Cladophora*, *Porites* and *Caulastrea*. Except for miliolids, porcelaneous LBF are rare.

Mesotrophic and probably turbid conditions prevailed, because Upper Eocene carbonates formed off estuarine/deltaic areas shedding terrestrial material from the north (Black Forest, Vosges) into the Helvetic realm and from the advancing South Alpine nappes into the Lombardian South Alpine Realm, where Priabonian shallow water carbonates are known from deep-water resediments only (Ternate Formation).

While Eocene orthophragminds have no recent representatives, modern nummulitids, such as *Operculina* spp. have been dredged off Brunéi Darussalam (NW-Borneo) under the mesotrophic fringe of the South China Sea from depths down to the shelf edge (140 m) where they lived on muddy substrates under mesophotic/mesotrophic conditions. Further investigations of deeper mesotrophic shelf areas may perhaps reveal modern equivalents of the Upper Eocene corallinacean, LBF-rich carbonates.