A new proposal for the Middle-Late Triassic paleogeography and tectonic evolution of the central Northern Calcareous Alps (Austria)

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The Northern Calcareous Alps (NCA) (Eastern Alps) were dominated through most of the Middle to Late Triassic by shallow water conditions in a post-rift setting, with the widespread deposition of thick platform carbonates (namely the Wetterstein and Dachstein limestones and dolomites). These shallow water Triassic platform carbonates dominate the outcrop of the NCA. In the area of the Salzkammergut in the central NCA the dominance of shallow water limestones is interrupted by the frequent appearance of geographically restricted outcrops of time-equivalent deep-water carbonate deposits (informally grouped into the Hallstatt facies), typically in association with Permian-age evaporite bodies of the Haselgebirge Formation. The distribution of deep and shallow water carbonates during the Triassic in the central NCA has been found to correspond to the areal distribution of structures cored by the Haselgebirge evaporites. These evaporite structures were mostly broad salt ridges (few hundreds of meters to few kilometers wide) that stretched forming a network of NW-SE and SW-NE structures. These orientations are inferred to correspond to the inherited passive margin structure of the underlying pre-Permian basement. During Permian to Early Triassic rifting, extension in the NCA was accommodated along SW-NE structures, with NW-SE structures acting as relay or transfer zones. During the post-rift the Haselgebirge nucleated salt ridges above these structures and further acted as a gliding surface for the Middle to Upper Triassic post-rift sedimentary units. Gliding of the sedimentary package led to differential development of the NW-SE and SW-NE directed salt structures. In contrast to the rifting phase, the structures in the SW-NE experienced limited extension whereas the NW-SE structures concentrated the greatest amounts of extension. As a result, SW-NE structures grew as diapiric structures at or near the seabed up to the Late Triassic, before being mostly covered by Upper Triassic platform carbonates. NW-SE structures in contrast developed as subsiding salt ridges, with a pronounced negative bathymetry around an axial swell. It is in these NW-SE oriented structures that the Hallstatt Facies were preferentially deposited, flanked by units that transitioned into the surrounding shallow water reefs and platforms. This relatively simple picture has been strongly overprinted by younger tectonic events including Late Jurassic shortening of the salt structures, Early Cretaceous Eoalpine thrusting, Late Cretaceous development of synorogenic basins, and Neogene strike-slip tectonics associated with lateral extrusion. All of these events recycle the original salt-cored structures in different, and sometimes complex, ways. Of particular relevance is the Late Jurassic shortening episode, as it is the one that is mainly responsible for the closure of the largest evaporite bodies and the juxtaposition of Triassic shallow and deep water carbonates. The proposed tectonic evolution is based on an integrated tectono-sedimentary approach and has an impact on the understanding of the early stages of Alpine orogenesis in the Eastern Alps and of the relative contribution of salt tectonics in the post-Triassic structural evolution.