

Ophiolitic detritus in Kimmeridgian calcareous basin sediments: Ophiolite obduction as cause for the Middle to Late Jurassic tectonic processes in the Northern Calcareous Alps (Austria)

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The causes for the Middle to Late Jurassic tectonic processes in the Northern Calcareous Alps are still controversially discussed. There are several contrasting models for these processes, formerly invented as “Jurassic gravitational tectonics”.

Whereas in the Dinarides or the Western Carpathians Jurassic ophiolite obduction and a Jurassic mountain building process with nappe thrusting is widely accepted equivalent processes are still questioned for the Eastern Alps. For the Northern Calcareous Alps an Early Cretaceous nappe thrusting process is widely favoured instead of a Jurassic one, obviously all other Jurassic features are nearly identical in the Northern Calcareous Alps, the Western Carpathians or the Dinarides. In contrast, the Jurassic basin evolution processes as best documented in the Northern Calcareous Alps were in recent times adopted to explain the Jurassic tectonic processes in the Carpathians and Dinarides. Whereas in the Western Carpathians Neotethys oceanic material is incorporated in the mélanges and in the Dinarides huge ophiolite nappes are preserved above the Jurassic basin fills and mélanges, Jurassic ophiolites or ophiolitic remains are not clearly documented in the Northern Calcareous Alps.

Here we present chromium spinel analyses of ophiolitic detritic material from Kimmeridgian allodapic limestones in the central Northern Calcareous Alps which clearly evidence Late Jurassic erosion of obducted ophiolites before their final sealing by the Late Jurassic–earliest Cretaceous carbonate platform pattern. The new data of detrital chromium spinel grains in the western central Northern Calcareous Alps result in the following conclusions:

1. Erosion of the obducted ophiolite stack started in the Kimmeridgian and not in the Early Cretaceous as previously assumed. This clearly indicates that the first thrusting event related to ophiolite obduction (upper plate) in the Northern Calcareous Alps is of Jurassic age. In a Jurassic strike-slip tectonic environment redeposition of eroded oceanic crust cannot be expected.
2. Geochemical composition of the detrital chromium spinels points to a harzburgite provenance. The (Jurassic SSZ) ophiolites occur in a higher nappe position as the (mainly) Iherzolitic (Triassic) ophiolites, as proven in the ophiolite nappe stack e.g. in Albania (Mirdita ophiolites).
3. The southern Northern Calcareous Alps underwent the same Jurassic to Early Cretaceous geodynamic history as the Western Carpathians, the Dinarides, and the Albanides/Hellenides with Middle to early Late Jurassic ophiolite obduction and the onset of erosion of the ophiolitic nappe pile in the Kimmeridgian. A Kimmeridgian to earliest Cretaceous carbonate platform evolved on top of the nappe stack including the obducted ophiolites. Erosion of the obducted ophiolite nappe stack started in the Kimmeridgian and lasted until the late Early Cretaceous (Aptian), but interrupted by the (Late) Kimmeridgian to earliest Cretaceous platform evolution, which protected the ophiolite nappe stack against erosion during that time span. In the Early Cretaceous also this platform was widespread eroded and can only be reconstructed by pebble analysis from mass flows in the Lower–Upper Cretaceous sedimentary successions.