The first direct evidence of the Jurassic ophiolitic obduction in the Eastern Alps (Austria): mass input of detritic Cr-spinels in Kimmeridgian sediments of the central Northern Calcareous Alps

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In the Kimmeridgian allodapic limestones near the Mt. Dietrichshorn in the central Northern Calcareous Alps (Hallstatt Mélange area of the Saalach zone), rich ophiolitic detritus in form of chrome-spinels was recorded. The Kimmeridgian age of the limestones is proven by the occurrence of the benthic foraminifera *Protopeneroplis striata* and *Labyrinthina mirabilis*, the dasycladalean algae *Salpingoporella pygmea*, and the alga incertae sedis *Pseudolithocodium carpathicum*. From the geochemical composition the analysed spinels have a dominance of Al-chromites (Fe^{3+}–Cr^{3+}–Al^{3+} diagram). In the Mg/(Mg+Fe^{2+}) vs. Cr/(Cr+Al) diagram they can be classified as type II ophiolites and in the TiO_2 vs. Al_2O_3 diagram they plot into the SSZ peridotite field. This points to a harzburgite provenance of the analysed spinels as known from the Jurassic suprasubduction ophiolites well preserved in the Dinarides/Albanides. These data point to the Late Jurassic erosion of obducted ophiolites before their final sealing by the Late Jurassic–earliest Cretaceous carbonate platform pattern.

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 designated "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 still widely favoured instead of a Jurassic one, obviously all other tectonostratigraphic Jurassic features are nearly identical in the Northern Calcareous Alps, the Western Carpathians and the Dinarides, especially the formation of the Middle and Late Jurassic sedimentary Mélanges (Hallstatt Mélange in general). In contrast, the Jurassic basin evolutionary 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, because they are eroded in the area of the today´s southern rim of the Northern Calcareous Alps.

To conclude: The Eastern Alps, Western Carpathians, Southern Alps, units in the Pannonian realm and the Dinarides/Albanides/Hellenides were all affected more or less contemporaneously by Middle-Late Jurassic ophiolite obduction and belong therefore to the same paleogeographic domain, i.e. the northwestern and western shelf of the Neotethys ocean. The existence of several independent oceanic domains between microcontinents cannot be confirmed. The proof for eroded obducted ophiolites in the Late Jurassic by our analyses complete the picture of a northeast-southwest-southeast striking orogen (from Tisza in the northeast to the Dinarides to the west and the Hellenides in the southeast) in Late Jurassic times, the Neotethyan Belt.