

What was the original paleogeographic position of the Rhenodanubian Flysch (Eastern Alps, Austria)?

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The Rhenodanubian Flysch is a complex of tectonic units continuously outcropping along the frontal part of the Eastern Alps. These units lay on the European Helvetic units, and are overthrust by the Northern Calcareous Alps (Adria plate margin). The Rhenodanubian Flysch consists of a Cretaceous shaly "basal complex", followed by Coniacian-Campanian and Maastrichtian-Ypresian formations, indicating that the basin was undeformed till lower Eocene time.

Even if the Rhenodanubian Flysch represents one of the most striking features of the Eastern Alps, due to intense deformation and poor outcrops, its original paleogeographic position is poorly constrained. As these units are closely associated to both ophiolite and Helvetic units, they are traditionally interpreted as originally located at the edge of the European basement.

If we zoom out from the Eastern Alps, Helminthoid Flysch with similar age and comparable facies assemblages are observed in the both Western Alps and Northern Apennines. In the Western Alps, the Parpaillon and San Remo units consist of shaly "basal complex" (upper Cretaceous) and by a Campanian-Maastrichtian Helminthoid Flysch, locally with the intercalation of sandstones. No tertiary sediments are observed. These units are completely detached from the substrate, and lay on the Briançonnais and Delphinois Units of the European margin.

In the Northern Apennines the Helminthoid Flysch Units are widely exposed, and are grouped into the External Ligurian Units. With the only exception of the Antola Unit, the External Ligurian Units are thrust to NNE directly over the Adria Margin and are in turn overthrust by the Internal Ligurian Units, consisting of ophiolites and sediments of the Ligurian Ocean.

Two kinds of "basal complexes" are observed in the External Ligurian Units. Some have blocks of various origin (ophiolites, granitoids, granulites, sedimentary rocks), indicative for a source area with a thinned continental crust. Other units display a basal complex with upper Cretaceous shales and thin turbidites. The Flysch is usually referred to the upper Campanian-Maastrichtian, with Tertiary siliciclastic turbidites (Paleocene or Lower Eocene).

Due to the characteristics of the "Basal Complex" and the tectonic position, the External Ligurian Units are located at the transition zone between Adriatic and Ligurian crust.

The similarities between the Helminthoid Flysch of the Alpine-Apennine System suggest to locate these units in the same paleogeographic region, that based on the presented data was located at the edge of the Ligurian Ocean, close to a thinned continental crust (either Adria or Europe, based on the interpretation).

The tectonic position of the units in both Eastern and Western Alps is compatible with both paleogeographic interpretations. More complex to explain is the position of the External Ligurian Units in the Northern Apennines, as they are squeezed between the remains of the Ligurian ocean and the Adria margin, suggesting that the original position of these units was close to Adria. With this interpretation, we can speculate that in the Eocene part of the Flysch Units experienced an Alpine deformation with thrusting towards Europe, whereas the rest of these units remained close to the original position and were subsequently included in the Apennine structures.