New paleomagnetic data from the northern and southern Alpine foreland: Constraints on the geodynamic evolution of the Alps

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Any contributions concerning dating of geodynamics by paleomagnetic tools can only be done by using the method of magnetostratigraphy and well defined events of reversals of the earth magnetic field, based on primary paleomagnetic data. Most previously published paleomagnetic studies in the Alps are identifying remagnetization events to be responsible for the magnetic information stored in samples (Gallet et al., 1993; Pueyo et al., 2002; Schätz et al., 2002; Thöny et al.,2006). The remagnetization events are mostly related to active folding. Primary paleomagnetic data from the Alps are scarce. The age of remagnetizations is critical for their interpretation. Dating of remagnetization events can only be done by combining magnetic with geologic data including the information about the age of folding and the kind of remagnetization (post-synfolding). In this study, we present data from the northern foreland basin from the Allgäu area and from the southern foreland basin from the Belluno/Bassano area.

In the allochthonous and tilted ("subalpine" and "aufgerichtete") Molasse of the northern Alpine foreland basin of the Allgäu area a pervasive postfolding overprint with a NW-trending declination can be identified which indicates counterclockwise rotation after folding. Presently, such results are documented from rocks up to Aquitanian to Burdigalian age (Upper Marine Molasse). These sites are also located geographically most northern, i.e. in the tilted part of the autochthonous Molasse. A trend toward decreasing counterclockwise rotation can be explained in two ways: either the rotation amount is decreasing through time or the most northern located sites represent the transition to unrotated parts of the Northern foreland basin and are therefore less rotated. The age of folding can be derived from seismic sections (Berge & Veal, 2005; Ortner, this volume). The triangle structure at the Alpine front is overthrust in post Serravallian times as sediments of the Upper Freshwater Molasse are tilted on top of it. The triangle structure is overthrust by the duplex of the Allochtonous Molasse, and thrusting in the allochthonous Molasse is therefore post-Serravallian.Combining paleomagnetic and geologic information dates the counterclockwise rotation younger than Serravallian, as the counterclockwise rotation has to be younger than the observed postfolding remagnetization and folding is younger than the

youngest deformed sediments.
In the Southern foreland basin we were working on sites from the Belluno syncline and the Bassano anticline. The south dipping Messinian Montello conglomerates at the southern limb of Bassano anticline represent the youngest sediments in the area. Samples were taken from sandy marls. The demagnetization methods are identifying two components of the NRM (natural remanent magnetization). A higher coercive component was acquired before tilting and is interpreted to be primary. A second low coercitive component is representing a postfolding remagnetization and was calculated in insitu position. In both cases the inclinations are about 60°, the declinations are also similar indicating 20°- 30° of counterclockwise rotation. Again the time of counterclockwise rotation can be dated by combining paleomagnetic and geologic data. The folding of the Messinian sediments is of course younger than Messinian. As primary and secondary (postfolding) magnetizations show similar values of vertical axis rotation, the rotation has to be younger than the folding of the sites, i.e. younger than Messinian.
In a previous study (Thöny et al., 2006) a joint counterclockwise rotation of Eastern and Southern Alps was related to the opening of the Balearic sea (Muttoni et al., 2001). The Corsica/Sardinia rotation is caused by that opening as well. Speranza et al.(2002) were dating the Corsica/Sardinia rotation by Ar/Ar-method on rotated volcanites to 19–16Ma. Paleomagnetic and geologic data from northern and southern Alpine foreland basins are indicating both counterclockwise rotations that were active younger than 10Ma (Serravallian) and younger than 5Ma (Messinian). Consequently these rotations can not be related to the opening of the Balearic sea. On the other hand the opening of the Tyrrheninan sea starts at about 10–5Ma (Gueguen et al., 1998) causing the counterclockwise rotation of Adria (Marton et al., 2003; Marton et al., 2002).
To conclude we interpret the observed counterclockwise rotations in the northern and southern Alpine foreland basins to be also caused by the opening of the Tyrrheninan sea. Consequently we possibly have to face a mega unit consisting of Eastern-Southern Alps and Adria that is rotating about 30° counterclockwise in Miocene to Pliocene times.