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Paleomagnetic evidence for large en-bloc rotations in the Eastern and Southern Alps during Neogene orogeny

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We present new paleomagnetic data from the Northern Calcareous Alps, the Central Alps of Austria and the Italian Southern Alps from 58 sites in Permian to Oligocene rocks (FWF P13566-TEC). Most of the magnetisations are overprints, which can be subdivided into two groups: the older overprint magnetisation is found in rocks not younger than earliest Oligocene and is characterized by NE trending declinations. The younger overprint displays counterclockwise rotated declinations and is found also in rocks younger than Early Oligocene. This is supported by primary magnetisations in Oligocene dykes from the Campo basement.

Our results together with the reinterpreted results from previous paleomagnetic studies (e.g. Channell et al., 1990, 1992; Mauritsch & Becke, 1987; Mauritsch & Marton, 1995) suggest joined vertical axis rotation of the Northern Calcareous Alps, Central Alps and Southern Alps throughout the Cenozoic. Two main phases of vertical axis rotation affected the Alps. A first event of clockwise rotation during the Early Oligocene, which was probably caused by the collision and blocking of the Alpine wedge with the spur of the Bohemian massif in the eastern part of the Alps, while the western part could still move freely to the north. With respect to the Cenozoic Alpine orogeny, clockwise rotation affected the upper plate units, which are the Austroalpine units and the Southern Alps, and lower plate units already accreted to the upper plate in the Early Oligocene. The second, counterclockwise rotation occurred in the Late Oligocene to Middle Miocene. In this stage of orogeny, the internal massifs of the Western Alps were already accreted to the upper plate and therefore included in counterclockwise rotation (Thomas et al., 1999; Collombet et al., 2002). This rotation is contempora-

neous with counterclockwise rotation in the Apennines and opening of the Balearic basin (Muttoni et al., 2001) and a genetic relationship is suggested.

A second step of counterclockwise rotation, reconstructed from published data, is observed in the sedimentary basins at the southeastern margin of the Eastern Alps, where counterclockwise rotated Miocene and Pliocene sediments are present (Marton et al., 2002a, 2002b). This rotation is seen in connection to a young counterclockwise rotation of the Adriatic plate (Marton et al., 2003).

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