Linking surface kinematics to deep structure of the Adriatic indenter near a potential switch in subduction polarity – the Giudicarie Belt (Southern Alps)

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This is a seismotectonic study of the Giudicarie Belt (GB), a transverse zone that subdivides the Alps into an eastern part marked by orogen-parallel extrusion of orogenic crust and a western part with well-developed pro-and retro-wedges (**Fig. 1**).



Figure 1: Tectonic map of the Alps with target area (yellow box) containing Giudicarie Belt (GB)

Our project tests the idea that Miocene kinematics at the leading edge of the Adriatic indenter is related to a proposed switch in subduction polarity along the Alpine chain as imaged in body-wave tomography, from a SE-dipping slab anomaly in the west to a subvertical to north-dipping anomaly in the east.

The object is to trace both active and inactive faults associated with the GB down to lithological, structural and seismological discontinuities in the crust and upper mantle. Prime targets include (1) a potential lithospheric tear in the vicinity of the GB, (2) a purported crustal wedge in the Tauern Window area, and (3) thrusts extending from the GB and the eastern Southern Alps into the Veneto-Friuli foreland basin. To map the 3D geometry of faults, we will use data from SWATH D and the AlpArray station network to pinpoint low-magnitude events and to delineate offsets of rock-physical domains (Vp, Vp/Vs, Qp, Qs) by using local earthquake tomography. This will be complimented by state-of-the-art structural and kinematic (fault-slip) analyses of thrusts and folds along 5 lithospheric profiles crossing key parts of the GB and adjacent units of the Southern and Eastern Alps (Fig. 2). The results will be integrated with data along the TRANSALP section as well as with existing thermo-chronological data at the surface to develop a fully 4D model of late Alpine collision and Adriatic indentation.



Figure 3: Tectonic map of the Giudicarie Belt and its 5 structural domains; blue-gray outlines part of the dense seismic station network (Swath D) used in this study.

Preliminary work shows that the magnitude and rate of seismicity in the Giudicarie-Veneto-Friuli target area (**Fig. 3**) allow the use of local earthquake tomography, doubledifference localization and receiver functions to image the Moho, as well as km-scale shear zones in the crust and upper mantle. The aforementioned lithospheric profiles will be tectonically balanced and the resulting shortening patterns and rates compared with Adria-Europe convergence to see whether the kinematics have remained the same through time, or have changed in response to rotation, and possibly N-directed subduction of the Adriatic plate.



Figure 3 - Seismicity in the Central, Eastern and Southern Alps: (a) SHARE catalog 1000 – 2006, $M_L >$ 3; (b) Local networks, 13 months, M_L 0-4 (1.11.2014-30.11.2015). Events in (b) are colorcoded according to local network specified.

This proposal addresses SPP research themes 1, 3 and 4, and is part of activity fields 1, 3, 4, and 5. Besides its dependence on the densified station swaths and the AlpArray network, it is closely linked to studies in the Eastern Alps and Tauern Window (Pleuger et al.), at the transition from Alps to Dinarides (Grützner et al.), as well as to structural along the TRANSALP thermochronology section (Glotzbach & Klev) and thermomechanical modelling of reversals in subduction polarity (Rümpker & Schmeling).

Two PhDs are involved in this project and will work in the Giudicarie, Veneto and Friuli areas: (1) Azam Jozi Najafabadi (GFZ-Potsdam) will process the incoming data from Swath D and the AlpArray network to create crust models extending down to the base of the crust mantle; (2) Vincent Verwater (FU-Berlin) will gather fault-slip data and tectonically balance cross sections across the GB, the Southern Alps and the Periadriatic Fault. Their work is closely linked with the aim of generating a series of 3D reconstructions of crustal and mantle structures reaching back in time. Collaboration is international, with a coapplicant in Zürich (Vincenzo Picotti, ETH) and cooperation partners in Austria (Hannah Pomella, Innsbruck; Bianca Heberer, Salzburg), Italy (Alfio Viganò, Trento; Stefano Parolai, OGS), Slovenia (Marko Vrabec, Llubjana) and Switzerland (Tobias Diehl, Eduard Kissling, ETH).