Peri-Tyrrhenian Geodetic Array, Western Mediterranean

John S. Oldow » University of Idaho

In 1995, a collaborative research project involving the University of Idaho, University of Napoli Federico II, the University of Palermo, and the University of Siena deployed the Peri-Tyrrhenian Geodetic Array (PTGA) to better understand the active tectonics of the orogenic belt bordering the southern Tyrrhenian Sea (Figure 1). The PTGA consists of 24 GPS sites distributed in six clusters across southern mainland Italy, Sicily, and Sardinia. Location of domains encompasses long-established tectonic regions, and specifically the western extensional province, the Apenninic frontal thrust belt and northern Apulian margin, the southern Apennines-Calabrian arc boundary, the Sicilian frontal thrust system and Hyblean foreland, the Tyrrhenian margin of NW Sicily, and southern Sardinia.

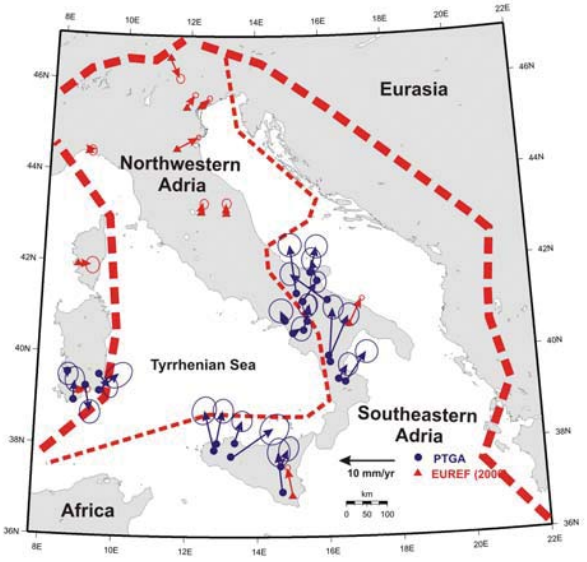

Figure 1. The Adriatic microplate, Adria, in the central Mediterranean showing IGS and PTGA velocities in a fixed European frame (after Oldow et al., 2001).

All the sites consist of steel monuments drilled and cemented into bedrock with the location of the site established to monitor differential motion between known or suspected tectonic blocks. Geological criteria were pivotal in site selection, favoring locations on structurally coherent blocks and sufficiently away from active faults. Baselines within clusters are consistently less than 100 km and baselines between clusters vary from about 100 to 650 km.

The network was reoccupied in 1997 and again in 2000. The data were aligned with International GNSS Service (IGS) sites at Matera (MATE), Noto (NOTO), and Cagliari (CAGL) in southern Italy, Sicily, and Sardinia, respectively. Using Bernese 4.2 data were processed and a regional velocity field developed in ITRF00 and a local European-fixed frame (Oldow et al., 2001). When combined with IGS velocities for sites in and around the western Mediterranean and Europe, differential displacement was recognized between parts of mainland Italy and sites surrounding the southern Tyrrhenian (Figure 1). Northern Italy and Sardinia show little or no differential motion with respect to Europe, whereas the southern mainland and Sicily exhibit differential displacements of up to 12 mm/yr. When taken together with the spatial distribution and first-motions of seismicity for the same region, the implication is that Adria, a microplate underlying much of the central Mediterranean is fragmenting into northern and southern sectors. The northern part of Adria essentially is attached to Europe, whereas the southern part of the microplate is moving in response to the convergence between northern Africa and Europe (Oldow et al., 2001).

When viewed in the local reference frame, fixed on foreland sites (MATE and NOTO) in the southern peri-Tyrrhenian orogen, differential motions clearly correspond to the spatial distribution of contractional and extensional fault systems recorded in earthquake focal mechanisms (Oldow and Ferranti, 2005). The seismicity and GPS velocities record a complex pattern of differential motion amongst crustal blocks. Coeval transpressional and transtensional belts within the orogen are kinematically coordinated and are consistent with displacement above a throughgoing basal decollement system that separates the heterogeneously deforming upper and middle crust from the presumed pattern of regular displacement within the underlying lithosphere. The implication is that seismicity and GPS velocities within the orogen reflect only indirectly the relative convergence between Africa and Eurasia.

References

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