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New geochronologic and thermochronologic data from the Einstein Telescope candidate site of Sardinia (Italy)

The candidate site for the Einstein Telescope (ET) in Italy is situated within the high-topography crystalline basement of northeastern Sardinia, selected for its seismic stability and isolation from significant active faults and hydrothermal circuits. To constrain this geological stability in unprecedented detail, we investigate the crucial role of time in assessing relief formation. Mountain ranges owe their existence to the interplay between tectonics, isostasy, magmatism, and surface processes.

In this communication, we provide the two geochronological endmembers—the oldest and the youngest ages—that can be applied to the thermochronological evolution of the studied crystalline area. Specifically, this study presents new preliminary constraints on the magmatic and erosive processes as part of our 4D characterization plan for the region.

Zircon crystals from five samples have been dated using the U–Pb dating technique, providing the first age estimate for the magmatism associated with the Bitti intrusion, dated at 320.9 ± 1.0 million years (Ma). Additionally, significantly older ages ranging from 479.3 ± 1.3 Ma to 468.5 ± 1.7 Ma have been determined for the gneisses of the plateau area. To explore the cooling history of the region, samples spaced across an elevation profile yield apatite (U–Th)/He ages (AHe), ranging from 68 ± 6 Ma on the Mamone plateau to 36 ± 3 Ma in the Rio Mannu Valley near Bitti village.

Based on these preliminary findings, we provide initial estimates for the intrusive rocks of Bitti, dating back to the middle Carboniferous, approximately at the beginning of magmatic activity in the Corsica-Sardinia Batholith. Furthermore, available cooling ages suggest the removal of ~2 km of rocks from the plateau. A first estimate of the exhumation/erosion rates, since Paleocene-Eocene time, shows very low values (maximum 0.06 mm/yr) compared to worldwide tectonically active regions characterized by values up to two-four orders of magnitude higher.

In summary, the geochronological analysis underscores the ancient origins of the region's rocks while highlighting the limited impact of recent erosion and tectonic activity on its topography. Further U–Pb dating and thermochronological analyses will provide a better understanding of the magmatic and erosive processes shaping the area.

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