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Unraveling 20 My of history of a volcanic complex: The Montiferru area (Italy)

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The Montiferru area (West Sardinia) geological history started in the Aquitanian, when it was part of the Western Mediterranean volcanic arc which run across the island, followed by marine transgression and regression ending in early Pliocene. Renewed volcanic activity started about 4 My ago and continued for at least 2 my. As a result, the geology of the area is the product of three volcanic cycles, either separated by marine transgressive phases or significant erosion. Superposition of volcanic structures with significantly different geometry and dynamics (calderas, dome complexes, stratovolcanoes and lava plains) within a relatively small (approximately 400 km²) area generated a geological complexity which makes the Montiferru a type locality for volcano- structural and sedimentary studies. The Montiferru was, until now, poorly characterized despite numerous previous studies, mainly focusing on the Plio-Pleistocene magmatic activity. Understanding the geological structures of the area requires reconstructing the style of activity and the landforms generated by each volcanic stage, multistage paleotopography reconstructions and the identification of the main structures controlling shallow magma accumulation and rise. In this study we fully describe the geology of the area based on Unconformity Bounded Stratigraphic Units (UBSU) and introduce 6 synthem (Sirisi, Santa Caterina di Pittinuri, Ghisos, Cùglieri, Campeda, Seneghe). The Sirisi Synthem comprises a calcalkaline Miocene caldera and associated ignimbrite plateau which is now only partially exposed, and covered by an upper sedimentary succession up to 200 m thick and made by limestones, marls and sandstones (Santa Caterina di Pittinuri synthem). These two synthem constitute the basement of the future Pliocene-Pleistocene volcanoes. The Sirisi synthem also comprises diffuse evidence of epithermal ores (Au, Pb-Zn-Cu-Fe sulfides and abundant iron oxides) with different styles of mineralization from veins to stockworks and disseminations, mostly limited to the intracaldera units. Ores are associated to widespread rock hydrothermal alteration, including propylitization, argillification, potassic alteration and a distinctive hematitization. The Pliocene volcanic units are grouped into three synthem (Ghisos, Campeda and Seneghe) separated by a regional unconformity associated with multiple failures of the flanks of the Pliocene-Pleistocene volcanic edifice, generating debris-avalanche deposits (Cùglieri synthem), here described for the first time. This activity was marked by emission of basanitic to phonolitic lavas and domes and minor (Vulcanian to Subplinian) explosive activity (Ghisos synthem). Finally, the last volcanic cycle corresponds to the massive basaltic eruptions of the Campeda plain (Campeda synthem), which were emitted mostly from NNE-SSW fissures and extend further east of the Montiferru area covering an area of about 850 km². This activity ended about 2 my ago, with cinder cone eruptions associated with small lava

flows with basanitic to basaltic composition (Seneghe synthem).