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Multidisciplinary studies on ancient sandstone quarries of Western Sardinia (Italy).

Silvana Maria Grillo (1), Carla Del Vais (2), and Stefano Naitza (3)

(1) DICAAR, Università di Cagliari, Cagliari, Italy (grillo@unica.it) , (2) Dipartimento di Storia, Beni Culturali e Territorio, Università di Cagliari, Cagliari, Italy (cdelvais@unica.it), (3) DICAAR, Università di Cagliari, Cagliari, Italy (snaitza@unica.it)

The ancient coastal quarries of Mediterranean are increasingly considered geosites of multidisciplinary relevance. They are sites of historical-archaeological interest that show ancient techniques of stone extraction; they are significant for cultural heritage conservation and restoration, as sources of the stones used in ancient buildings and monuments; they are sites of geological relevance, as often retain important stratigraphic sections; they are also useful markers of secular changes in the sea level. A multisciplinary study is in progress on the ancient quarries of the Sinis region (western Sardinia island), integrating archaeological, geological, minero-petrographical data. In Sardinia, coastal quarries have been established from Punic and Roman times. Many of them exploited Quaternary sediments along the southern and western coasts of the island. They consist of middle-late Pleistocene marine conglomerates and carbonate sandstones, and of coastal (aeolian) carbonate sandstones. Sandstone blocks of different sizes have been widely used in ancient cities for buildings, defensive works, harbours, etc. Three main areas of stone extraction (San Giovanni di Sinis, Punta Maimoni, Is Arutas) have been so far recognized in the Sinis. GIS-supported mapping and documentation of the sites includes their geology and stratigraphy, the extension and layout of the quarries, and an evaluation of volumes of extracted rocks. Documented archaeological evidences include ancient extraction fronts, spoil heaps, working areas, working traces in the old fronts, transport routes of blocks, and traces of loading facilities. The study is aimed at reconstructing the relationships of the quarries with the urban areas of Sinis, as the ancient Punic-Roman city of Tharros. Consequently, a minero-petrographical characterization (optical microscopy, XRD) is performed on sandstones sampled in each quarry, and in historical buildings in Tharros and other centres of the region (Cabras, Oristano, Santa Giusta). They are prevailing fine-medium grained carbonate sandstones, and subordinate coarse sandstones and micro-conglomerates, variably cemented. In the studied areas, stratigraphic sequences grade from coarser facies of marine environment to fine-grained aeolian deposits, marked by cross-stratification. The Quaternary sedimentary sequence rests on Miocene limestones and clays, and on Plio-Pleistocene basalts. On optical microscopy, sandstones show grain-supported texture, with abundant carbonate bioclasts, intraclasts and algal nodules, with quartz, feldspars and fragments of granitoids, quartzites, volcanics. Grainsize in sandstone sequences progressively decreases towards the top, corresponding to an increase of fine bioclastic components. Terrigenous components change from the northernmost outcrops (Is Arutas quarries), where clasts of granitoid origin are dominant, to the southern outcrops (San Giovanni di Sinis quarries), which show a more marked compositional heterogeneity, with frequent volcanic feldspars and lithoclasts. The calcitic cement also shows distinct variations, both along the stratigraphic sequence and at areal scale, between the sparitic type and the micro/cryptocrystalline type. First evidences on samples from Tharros city walls indicate that sandstone blocks may come, almost in part, from the quarries of San Giovanni di Sinis that, consequently, could have started to work during the Punic age. Other evidences in the area, however, indicate that quarrying activities in Sinis continued well over the Ancient times, presumably including all the Middle Ages.