

EXCAVATIONS AT KESTEL MINE, TURKEY: THE FINAL SEASON

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During late July and August 1996, we completed the final excavation season at Kestel, the Early Bronze Age tin mine, located 2 km opposite Göltepe, the contemporary miner's village. Our University of Chicago/Boğaziçi University team was joined by specialist mining archaeologists from the Peak District Mining Museum in the UK, expertly led by Lynn Willies.

The Kestel program this final season aimed at excavating human graves and related features in the "Mortuary Chamber," which was first discovered in 1991. This abandoned mine shaft had evidently been reused in antiquity as a graveyard, something as-yet unknown in the history of prehistoric mining. Our intent was to investigate the initial ore extraction methods in the mine shaft and then date the graves. As part of the program to open the mine to tourism, six 150 watt floodlights were installed in the first chamber. Our other aim was to map surface features related to ore processing and openwork mining above the mine on the mountain slope. These areas around the entrance of Kestel Mine 1 and Mine 2 were targeted for excavation. Our last objective was to build a depot/storage structure with working space to house the ceramics, groundstone tools, and crucible fragments from both the Göltepe and Kestel excavations. The building, located in the Celaller village grammar school yard, would make these collections available to scholars seeking to do research projects on any of the Göltepe and Kestel finds in the future.

The underground galleries are extensive, measuring a minimum 4,600 m³. Fire-setting and hammering using large groundstone battering rams were the main methods of extraction. The earlier workings, found primarily in the northwestern sector of the site, are predominantly fireset and very small scale compared to the subsequent mining events. Later workings, which cut through the earlier, are larger in scope and evidence of both fire and heavy hammering are visible, perhaps indicating improved mining techniques. Extrapolating from the low-grade ore composition with 1% tin content (what remains today for analysis), the space extracted would have yielded about 115 tons of tin. Radiocarbon dating and pottery so far suggests that the major mining activities date to the Early Bronze II and III periods.

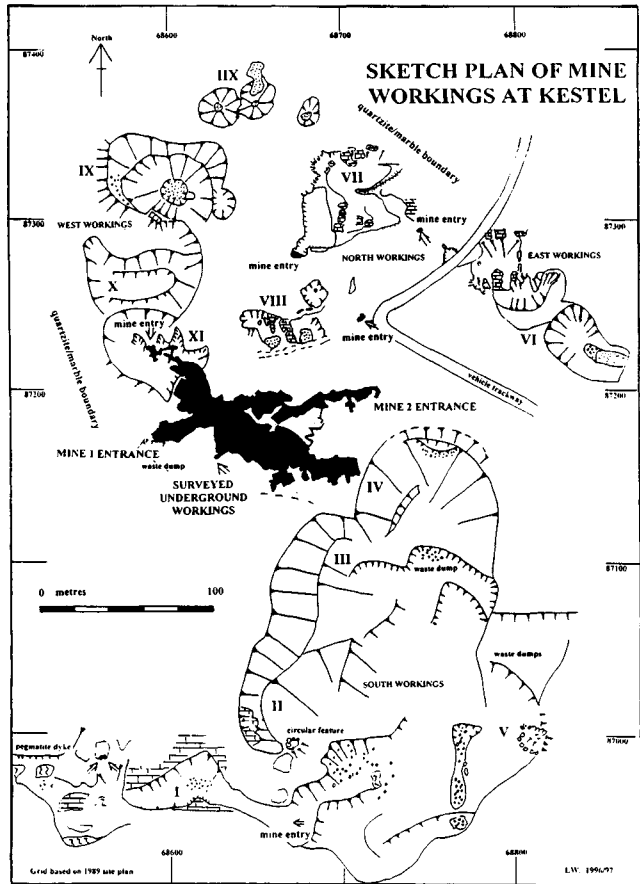
A trench was opened in the eastern end of the abandoned mine shaft, Kestel 2, Mortuary Chamber. At least three phases of use were identified in the stratified excavation sequence. The first and lowest phase constituted the extraction of ores, replete with rubble associated with mining. Early Bronze Age pottery fragments were identical to the types found at Göltepe village, thus dating the mining in this gallery to the third millennium BC. There had been substantial domestic use of the underground workings; perhaps they were even used for refuge. Inside Mine 2, at least two semi-subterranean pithouse structures constructed of stones had been built in the mine shaft after mining had ceased. These two pithouses were similar to the structures excavated at Göltepe and again contained stylistically similar Early

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Bronze Age ceramics. Finds also included a copper-based pin, a hematite weight, small amounts of antler, and an oven. Postdating the pithouse structures were the inhumations. The furthest extent of the Mortuary Chamber had a number of disarticulated human bones. Approximately a dozen persons had been buried in pits or extraction cavities. The ceramics found in association with this level indicates an Early Bronze III date for these graves. There had been later disturbance of at least some skeletal remains and probably breaking down of barriers separating inhumation areas from the rest of the mine-workings. The human skeletal material had probably been robbed in antiquity or perhaps carnivorous animals scattered the remains around the chamber.

Mine 1, too, had later use as a shelter. Earlier excavations in Mine 1, notably Trench 5, indicated use of the mine from the Byzantine period through modern times with no mining rubble associated with these levels. An adjacent, larger chamber had been modified by leveling the floor which had a surface scatter of pottery sherds. More recent use has been by animals leaving a variety of bones and coprolites.

At the surface, several trenches were put in to investigate the function and dating of the ore processing features surrounding the entrances of the mine shafts and open-pit mining zones. Trench T10 investigated the surface entrance of the Mortuary Chamber at Kestel Mine 2. While sinking the shaft into Mine 2 to gain entrance into the mine from the surface, a mixed level of fill was found containing pottery, antler, spindle whorls, and bones. When the trench was expanded, this area revealed an oven suggesting domestic use of the entrance area. Small scrappy walls of stone and several subphases at the entrance of the mine indicated certain organizational changes had taken place during the Bronze Age. Refractory crucible fragments, possibly from smelting activities at the surface, suggest that initial smelting occurred



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Team member at work in Kestel Mine

near the mine as well as on Göltepe hill. One such crucible was analyzed at the Conservation Analytical Laboratory of the Smithsonian Institution in 1992 and found to have a tin-rich interior surface, similar to the ones found at Göltepe. It is possible that the crucibles at Kestel could have been used to assay the ore for tin content in order to make strategic decisions during mining.

Again at the surface, another trench (T26) investigated the lower open-working area. A large stone mortar was found in situ with a central hollow shaped like a big foot. This was presumably used to crush and grind the ore to render it to powder consistency for ultimate smelting purposes. Trench T27 was placed at the original entrance of Kestel Mine 1 where an ore processing station was located. This work station demonstrated how cleverly the angle of the slope may have been used to wash the ore downslope and separate the tin from the iron and quartz by gravity. Ceramics found during the excavation of this trench demonstrated the contemporaneity of the workings to Kestel Mine 1 and Göltepe.

More open-workings are located in the broad shallow valley east of the hill and south of the Mine 2 entrance (II to V). Agricultural use has modified the waste heaps although the working faces are evident in the small western escarpment. Substantial openwork sites are found in the east (VI), north (VII), and west (VIII to XI) upslope as well. Characteristically sub-circular in shape with a working face up-hill, a crescentic dump is evident on the downside and in the hollow, depressed center a "working area" of broken stone can be seen. Some workings appear to have been cut down to bedrock under alluvial waste, while others were cut into the marble for a few meters depth. Some cut through older underground workings where they were shallow, especially through the small-scale workings northwest of Mine 1 (which may suggest contemporaneity with the large-scale underground

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workings that do the same). The large extraction areas on the northwest are in an as yet undetermined stratum, probably mainly quartzite, perhaps following a fault structure for ore.

The total volume of openwork type extraction cavities is still in a preliminary-estimate stage. Extraction figures for individual openwork sites, neglecting very small ones, range from around 1,000 tons to at least 15,000 tons. Technically a much lower grade ore was extracted than the underground workings, though once enriched deposits were reached, the yields within it could be high. A tentative guess would be that at least ten times as much was excavated at surface than underground, but with a yield perhaps only 10% as high, thus adding a further 100 tons to the total. Tentatively, total production estimates by our UK mining colleagues suggest a minimum yield for the whole Kestel site of around 200 tons of tin produced over perhaps a thousand years. Working such a low grade tin site was obviously worth the effort since tin still was a very rare and expensive commodity in the Early Bronze Age. Recovery of very small amounts of gold and use of hematite for pigment is also likely.

The sequence of ore production thus began at Kestel mine and openwork mining areas on the slope. Preliminary ore treatment was mainly at Kestel with final processing and smelting mainly at Göltepe. The termination of mining activity and the production site at the end of the third millennium BC suggests the discovery elsewhere of better-grade deposits and the arrival in the regional market of competing, cheaper supplies possibly brought in by the Assyrian trading colonies. It is also possible that the final stages of working were marked by dramatic climatic events which may have disrupted trade, which is evidently a matter of much debate lately.

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