Turkish tin mine revises Bronze Age history

By training their analytical tools on pottery fragments discovered in Turkey, scientists have pieced together a new picture of how Bronze Age people there obtained tin, a key raw material for making bronze.

Throughout the Near East, bronze artifacts from 4,500 years ago attest to the importance of this valuable copper-and-tin alloy to those cultures. In that region, archaeologists have unearthed many copper mines, with tons of waste ore, or slag, nearby.

"But we've known nothing about where the tin came from," says archaeologist Vincent C. Pigott of the University of Pennsylvania in Philadelphia. A few records have pointed to mountains in Afghanistan as the nearest source and described tin as a key trade commodity, he adds.

In 1989, however, archaeologist Aslihan Yener of the Smithsonian Institution in Washington, D.C., discovered tin ore at Goltepe, located in mountains about 500 miles southeast of Ankara, Turkey. Radiocarbon dating of charcoal residue on pottery fragments and another dating technique indicate that an ancient people extracted tin there around 2,500 B.C., says Smithsonian materials scientist Pamela Vandiver. She described the tin-extraction methods in San Francisco last week at the spring meeting of the Materials Research Society.

"It's not only the earliest, but it is also the only Bronze Age evidence to date of tin processing [in the Near East]," Pigott says.

At the Goltepe site, the Smithsonian researchers counted 250,000 grindstones near the mine's mouth. They also collected crucible fragments from remains of a walled compound with several pit houses.

By studying the chemical condition of 24 pottery fragments brought back to the Smithsonian, Vandiver and her colleagues pieced together this ancient process. They used X-ray fluorescence to analyze the fragment surfaces and black, glassy drops stuck to the fragments.

Today, mining companies extract tin by smelting ore: When heated to about 1,350°C, the tin flows out of the ore and settles on the bottom of a furnace. But early cultures could not attain such high temperatures. "They couldn't get a clean separation, what we call a smelt today," says Vandiver.

To obtain tin, ancient metal workers first ground rocks and stones into coarse powder. They then culled quartz and limestone from iron-rich magnetite and cassiterite, a tin oxide mineral. When ground finer, the purplish cassiterite breaks into smaller particles than the iron mineral, and can be separated out.

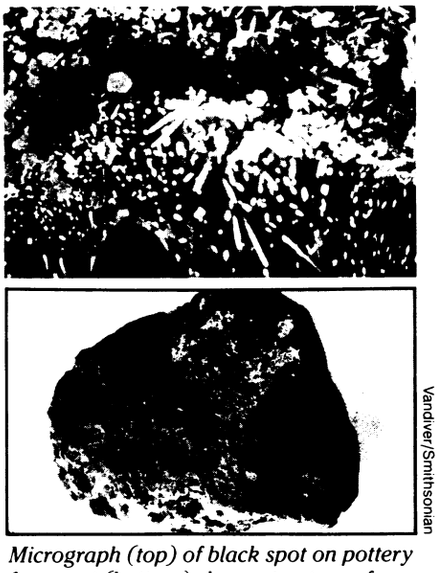
Vandiver concludes that to purify tin, the miners fired the powder in between layers of charcoal in shallow bowls. The charcoal heated the powder to about 950°C and – along with an arsenic compound possibly applied to the hot powder through a blowpipe – provided a chemical atmosphere that encouraged small beads of tin to crystallize in the hot, black, glassy melt. Crushing and reheating this material several times eventually enabled the workers to get tin to liquefy and ooze from the melt.

The process resembles glass-making technology from that period, says Vandiver. "We're slowly trying to build up a picture of third-millennium pyrotechnology," she adds. This technology made possible the fabrication of materials with stone-like qualities, symbolizing power and status. "Pyrotechnology supports kingship and the integration of large areas," Vandiver says.

This summer, British researchers plan to visit Goltepe, and will try to extract tin using this multistep, low-temperature technology, says Vandiver.

The new findings add weight to a growing belief that ancient cultures may have depended on small, local deposits of raw materials more than scientists thought, she says.

"It raises a lot of questions about the movement of this raw material," adds Pigott. "It makes the picture much more complicated." – *E. Pennisi*



Vandiver/Smithsonian

Micrograph (top) of black spot on pottery fragment (bottom) shows structure of sintered, glassy material containing tin oxide (white rods).

Tamoxifen trial begins amid new concerns

Last week, the National Cancer Institute (NCI) officially launched its long-awaited, drug-based breast cancer prevention trial. At 119 medical centers and some 300 related satellite institutions in the United States and Canada, physicians have begun formally recruiting 16,000 healthy women at high risk of developing breast cancer. The trial aims to evaluate whether prophylactic doses of tamoxifen, the most widely prescribed drug for treating breast cancer, will safely prevent breast cancer (SN: 4/25/92, p.266).

"Tamoxifen certainly is not a miracle cure" or without risks, said NCI Director Samuel Broder at a press briefing in Bethesda, Md., last week.

Indeed, University of Pittsburgh surgeon Bernard Fisher, the NCI trial's principal investigator, acknowledged that the synthetic hormone poses some increased risk of endometrial cancer and blood-clot-producing phlebitis. Other recently reported studies have indicated that tamoxifen may also spawn liver tumors, a type of breast cancer resistant to therapy and perhaps even malignancies of the gastrointestinal system.

Taken together, Fisher says, these adverse effects are "really relatively rare and infrequently severe enough to require discontinuation of treatment."

Nonmalignant liver disease appears to be the newest adverse effect associated with tamoxifen. In the April 11 LANCET, Richard G. Long and his co-workers at City Hospital in Nottingham, England, report the death of a 58-year-old patient receiving 20 milligrams of tamoxifen daily – the same dose that women will receive in the NCI prophylactic trial. Five months after the woman began taking tamoxifen, she appeared jaundiced and complained of lethargy, nausea and vomiting. Though her doctor immediately took her off the drug, she died soon thereafter. Autopsy revealed "acute hepatic necrosis – pure liver-cell damage," Long says, and suppression of neutrophils, white blood cells important in fighting bacterial infection.

An inquiry to the U.K. Committee on Safety of Medicines regarding other reports of tamoxifen-associated liver problems "revealed four similar cases of hepatic failure, three fatal, and five other cases of tamoxifen-associated hepatitis (one fatal)," the Nottingham doctors note. The committee also cited 11 other reports of liver complications.

Calls to NCI, the Food and Drug Administration and tamoxifen's maker – ICI Pharmaceuticals of Wilmington, Del. – found no similar reports of liver disease associated with U.S. tamoxifen use. Even in Britain, these liver problems remain rare, Long observes. However, he adds, "people are throwing this drug around like sweets, suggesting that it's totally safe and that large numbers of women should have it.... I now have doubts about that." – *J. Raloff*