ANTIQUE AUTHENTICATION

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through science

210Pb Testing

210Pb testing for the authentication of metal artifacts is based on the disturbance of the radiochemical equilibrium of the 238U decay chain during the smelting process. Ores and minerals accompanying the ore usually contain small amounts of uranium. In the decay chain of uranium elements different geochemical and metallurgical behaviors are produced; among these is the radioactive nuclide 210Pb. While lithophile trace elements like U, Th and Ra remain in the slag, chalcophile and siderophile elements, such as Bi and Pb, are taken up by the metal phase. Thus the short-lived radionuclide 210Pb (t1/2 = 22.3 y) is efficiently separated from its long-lived ancestors 238U (t1/2 = 4.4 * 109 y) and 226Ra (t1/2 =1600 y). The concentration of 210Pb in the metal depends on the geological setting of the ore and the manufacturing process, so the range of the initial activity is large, and therefore can not be used for dating. The 210Pb in the metal decays with its own half life of 22.3 years and as a result of the disrupted decay chain it cannot be renewed. (In discussions of radioactivity, the half-life (symbol $t_{1/2}$) of an isotope refers to the time it takes for one-half of the sample to decay. In the case of 210Pb, $t_{1/2}$ = 22.3 years.) This means that no radioactivity is measurable in metals older than approximately 110 years (~ five half-lives of 210Pb).
However, it should be noted that the absence of 210Pb is not proof of authenticity, as theoretically old metal could have been used to produce objects in modern times.

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