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Feasibility Study for Detecting the Lost Leonardo Mural by Prompt Gamma Neutron Activation

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There has been considerable interest in the application of nondestructive test methods for finding the lost mural of the Battle of Anghiari by Leonardo da Vinci in the Palazzo Vecchio in Florence, Italy. This mural was thought to have be painted in 1505, but it was subsequently covered over by another mural in 1560. Most recently, it has been proposed to use a neutron-based elemental analysis technique, prompt gamma neutron activation (PGNA), to detect elements characteristic of the pigments that Leonardo may have used. To determine the feasibility of this method for finding the lost mural, a preliminary analysis of the probability of detection (POD) has been made using the Currie Equation for estimating the minimum detectable limit for a given element. The first step was to determine the pigment most likely to be detected by PGNA. This involved identifying the palette that Leonardo may have used and then screening them for detectable elements by neutron capture cross-section, gamma ray energies and yields. In addition, interferences from elements in the materials surrounding the mural had to be taken into account. Based on this analysis, mercury, an element in the red pigment vermilion, was the most favorable candidate. The next step was to estimate the total mass of mercury in the field of view based on vermilion layer thickness and surface distribution. Finally, the mercury count rate was modeled using the operating specifications of existing portable prompt gamma neutron activation systems, including thermal neutron flux and gamma ray detector efficiency. It was concluded that the count rate would be too low to be practical.

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