Relationship between sediment and ceramic corrosion--The example of celadon from the Nanhai Ⅰ shipwreck

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Abstract: Ceramics excavated from the ground or out of the water are often covered with a layer of sediment, affecting the object's aesthetics and impacting its subsequent preservation. In this paper, taking 24 pieces of celadon ceramics from the Nanhai Ⅰ shipwreck as an example, using super-depth-field microscope, X-ray diffractometer (XRD), scanning electron microscope-energy spectroscopy (SEM-EDS), Raman spectrometry, etc., to study the types of deposits, deposition morphology and process, and the effect of deposits on glaze corrosion, and obtained the following results: ① The white sediments on the glazed surface were mainly aragonite, gypsum and clay particles. The transparent sediments are primarily composed of spherical boehmite and magnesium silicate as aggregates of curved flakes. The yellow sediments mainly comprise iron-rich magnesium silicate, acicular siderite and goethite, and iron-rich clay particles. The black sediments mostly contain iron-rich magnesium silicate and various iron-sulfur compounds. The reddish-brown sediments are mostly hydronium jarosite. ② Fe and Mg silicate deposits are common and formed when the glaze material is hydrolyzed with environmental ions. Mg and Fe silicate formation is highly dependent on the pH of the solution, requiring pH > 8 for magnesium silicate precipitation and pH > 6 for iron silicate precipitation at room temperature. Fe silicates are deposited first in crevices, followed by Mg silicates; in pores and surfaces, Fe silicates and Mg silicates are deposited simultaneously. The pH change of the solution, the availability of Mg, Fe, and Si elements, and the solubility of the secondary phase precipitation together affect the deposition morphology of the glaze corrosion layer. ③ The Fe and Mg silicate deposit layer accelerates the glaze's corrosion, and the glaze's corrosion promotes the formation of the deposit layer. ④ Mg and Fe silicates are hygroscopic and can form an alkaline microenvironment locally after excavation, thus accelerating the corrosion of the glaze and further deposition of Mg and Fe silicates. Therefore, keeping the ceramics in deionized water is recommended after they are excavated out of the water. At the same time, desalination treatment is carried out to remove the soluble salts, after which a weak acid solution is used to remove these two deposits chemically. The research results will provide supporting data for the subsequent scientific and

adequate protection of this batch of precious ceramics.

Keywords: Nanhai Ⅰ shipwreck; sediment; porcelain corrosion