Maya Blue: a Long Lasting Mystery Revealed

Giacomo Chiari[a], Roberto Giustetto[b], *[a]Getty Conservation Institute, Los Angeles, California. [b]Dip. Scienze Mineralogiche e Petrologiche, Universita' di Torino, Italy.* E-mail: gchiari@getty.edu

The composition of Maya Blue, one of the most important pigments in antiquity, has puzzled scientists for decades. Recent studies using different analytical techniques including synchrotron and neutron powder diffraction, proved that the pigment is a combination of palygorskite (characterized by large channels), and the organic dye indigo.

Pigment preparation was repeated successfully and is easy (mix clay and dye and heat at ~100°C for a few hours). Chemical modelling showed indigo fitting the channels without impediment, thus it was assumed that indigo would fully or partially occupy the channels. However, energy calculations and thermal analyses showed indigo cannot penetrate into channels, since the water present does not leave the channels at synthesis temperature and strong H-bonds formed by the first molecule in the channels need to be broken.

A new concept of Maya Blue structure is presented, based on the fact that indigo only fill the grooves present at the crystal's surface. These grooves, which can be thought of as half channels split along cleavage planes, can equally well accommodate the dye molecule, forming one or two H-bonds explaining the stability and colour of the complex. A possible line of study to determine the provenance of Maya Blue is based on mutual abundance of the monoclinic and orthorhombic polymorph of palygorskite, determined via Rietveld refinement. . On the basis of the new theory all the facts previously hard to explain, become comprehensible.

Keywords: maya blue structure, palygorskite, synchrotron and neutron powder diffraction