Analytical Imaging Techniques for the Authentication of Tortoise Shell

Lesley Day, lesleyday@ucla.edu
UCLA/Getty Master’s Program in the Conservation of Archaeological and Ethnographic Materials

INTRODUCTION

There are specific patterns, made up of swirling lines, found within and unique to tortoise shell, which likely correspond to the yearly depositions of keratin that occur as the turtle grows. This phenomenon has been observed, but has not been fully characterized and is little understood in any discipline. One patterning is topographical in antique tortoise shell samples, and a second pattern appears as darkened lines in an example that has suffered light damage. Documentation techniques including UV-induced visible fluorescence imaging and Reflectance Transformation Imaging (RTI) have proven to be extremely useful in observing and documenting the patterns, and the characterization of the patterns can be used as a diagnostic criteria for distinguishing tortoise shell from imitative materials such as plastic and horn.

Hawksbill turtle (Eretmochelys imbricata)

‘Moire’ Patternning

The ‘moire’ pattern is inherent to the keratinous scutes of the shell. It can be seen as topography on the ventral side of the scutes (top left) and appears to correspond to connective tissue that attaches the keratinous scute to the boney plates of the shell (top right). A second, possibly related pattern can also sometimes be seen as darkened, swirling lines through the transparency of the keratin (bottom images).

Detection of ‘Moire’ Patternning in Artifacts

Both relief and topographical ‘moire’ patterns are related to keratin formation, and both are indicative of tortoise shell rather than an imitation material. The current study-including light aging, and color and gloss measurement as well as imaging before and after aging-is underway to determine whether the enhanced patterning visible in artifacts is indicative of environmental exposure, or has another source.

Analytical Imaging

UV-induced Visible Fluorescence Imaging of Scutes

Costal scute, dorsal side, from a juvenile Hawksbill turtle. Diffuse light image (left) UVVF image adjusted to greyscale (right). Note the appearance of distinct lines that are part of (highlighted in green).

Reflectance Transformation Imaging of Scutes

Same costal scute as above, ventral side, with remnants of connective tissue present. Diffuse light image (left) and RTI image, specular enhancement mode (right) highlighting the presence of the tissue and associated topography of the pattern.

Highlighting the ‘Moire’ pattern on Tortoise Shell Artifacts

Diffuse Light

UV (greyscale)

RTI

The patterning is slightly visible in diffuse light, however it can be easily be overlooked.When viewed under a UV source, the lines of the embedded pattern become very apparent. RTI is very useful to document the topography of the relief pattern.

References