Lucía Pereira Pardo
The National Archives of the UK

## Revealing the colourful palette of a 17th-century mapmaker: Non-invasive chemical analysis of the pigments in Richard Bartlett's maps of Ulster

Richard Bartlett was an Elizabethan surveyor and mapmaker who worked in Ireland at the beginning of the 17th century, primarily for military purposes. There are 27 of Bartlett's manuscript maps in existence and some of them are striking in the use of colour. Although Bartlett's work has been investigated from a historical and geographical perspective, there has never been a close examination of his mapmaking process and the materials he used. The goal of this study is to analyse the pigments, dyes, inks and substrates in the maps by Bartlett held in The National Archives of the United Kingdom. To this end, only non-invasive techniques were used, so that no sampling was necessary: multispectral imaging (MSI), X-ray fluorescence (XRF), fibre optic reflectance spectroscopy (FORS), micro-Raman spectroscopy, diffuse reflectance for infrared Fourier transform spectroscopy (DRIFTS) and digital microscopy.

The analysis results showed that Bartlett used a mixture of iron gall and carbon-based ink for the text and the map outlines, and gold ink for the highlights. The colour palette included: vermilion, red lead, organic reds extracted from scale insects for pinks and transparent glazes, an organic purple likely from plants or lichens, an organic green, copper-based blues and greens such as blue verditer, an organic yellow and an almost unknown pigment: an orange-yellow synthetic arsenic sulphide glass. The materials analysis was also helpful to understand the degradation processes of some pigments in the map: the darkening of red lead was confirmed and the presence of pararealgar as a photo-degradation product of realgar was discarded. The painting materials identified are generally in agreement with those recommended in drawing and colouring treatises for map and print makers in the 16th-17th centuries, although evidence of a variation in the recipe to make the arsenic-based glass was found.

Further research will aim to expand the analysis to maps made by other surveyors/cartographers in Tudor England, shedding light on the particularities and similarities of their mapmaking, the standardisation of the cartography profession and the existence of different schools. To this end, advanced imaging spectroscopic techniques, such as hyperspectral imaging and macro-XRF scanning, will be used and the resulting data will be automatically processed using AI techniques. This project is one of the three case studies of a AHRC UK-US Collaboration for Digital Scholarship in Cultural Institutions Grant "AI for DIGILAB: A new concept in digital infrastructure for heritage materials research".

**Lucía Pereira Pardo** works as a Senior Conservation Scientist in the Collection Care department of the National Archives (UK). She has an interest in the non-invasive analysis of heritage materials, such as inks, pigments and dyes. Lucía actively participates in the design and development of research projects to study the collections at the National Archives from new and stimulating angles, which involve the analysis of their materiality and the use of computing methodologies. She also supports the day-to-day work of the paper and book conservators in Collection Care. Lucía is a committee member of the UK's Icon Heritage Science Group.

**Contact Information**: lucia.pereirapardo@nationalarchives.gov.uk