Access - Highlights Roberto Triolo

Investigation of Cultural Heritage relevant samples by neutron tomography

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The "UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage" and the 2004 London Conference "Sustaining Europe's Cultural Heritage: From Research to Policy", set the basis for a series of acts to support the Cultural Heritage of Europe. In this context neutron based techniques may play a fundamental role because neutrons are very penetrating and therefore ideal for non invasive investigation of bulk samples allowing both surfaces and bulk properties to be measured. In the following we'll present a couple of examples of neutron tomography applications. Between the 2nd century B.C. and the first century A.D. use of lead by the Roman empire grew up fast following the increasing request of lead for ship-building (military and commercial ships) and for pipe-building to serve the new city needs. Therefore, along the commercial routes of the Mediterranean Sea (which Romans considered as a sort of personal property, and in fact they called it also Mare Nostrum, i.e. Our Sea) there has been a heavy traffic of ships carrying lead materials, and especially ingots. Occasionally some of the ships would sink and the load has been for centuries buried in sea water. In fact, all the ingots show rectangular areas carrying stamped marks which are a combination of characters and images. In a sense these marks represent a sort of trademark of great importance for archaeologists, as possibility of reading the characters and seeing the images would allow to determine with high accuracy the age and the producer of the find. Clearly, a careful analysis of the lead ingots recovered from sunk ships will add information of archaeological interest. The area containing the marks has been covered with products of the corrosion mechanism, salt deposits and algae, so it would be necessary to scrape the surface layers to reach the stamped region. To avoid this invasive operation Neutron Tomography can be used for epigraphic analysis of lead ingots. An example is highlighted in figure 1 showing a photo of two portions of the ingot and the reconstructed NT image of the portions; the stylized leaping dolphin and the characters shown on the right are the result of the tomography analysis of the area shown in the photo. The experiment has been performed at BENSC.

In this case only neutrons could be used to perform the tomography experiments. In fact, the absorption coefficient of lead for neutrons is quite small and therefore large samples can be investigated. Another interesting feature of NT is shown in the figure below which shows a tomography slice obtained by means of X ray μCT (left) and of NT (right) of a sample of humid Chestnut wood. While X rays show a very clear image of the structure of the wood, show no indication of the presence of water. The NT image, on the other hand, appears "cloudy" because carries also the information of the distribution of the water molecules inside the wood. Clearly, when investigating the distribution of hydrogenated materials inside wood (for example in the case of conservation treatments) NT is the ideal technique, although a synergic use of XT and NT is to be preferred as information on both the structure of the wood and its modification by the treating material will be obtained.

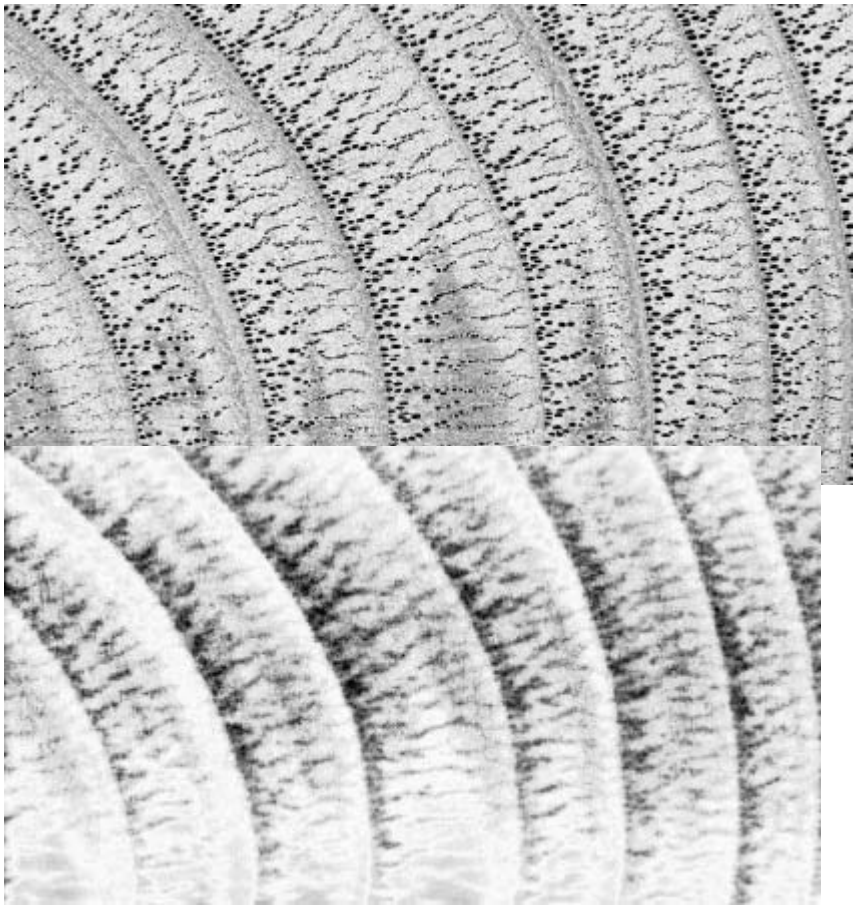

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Figure 1a) Photo

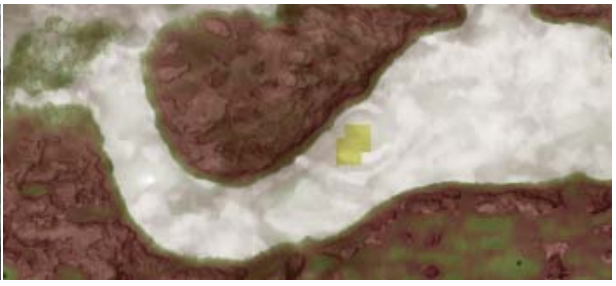

Figure 1b) Reconstructed NT Image

Figure 2a) Photo

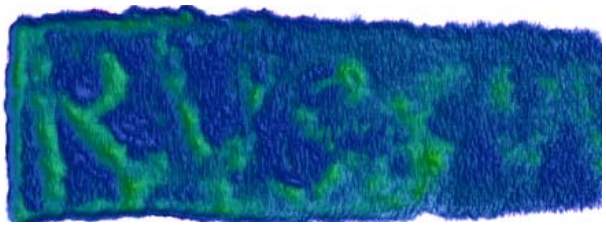

Figure 2b) Reconstructed NT Image

References

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