EUROPEAN LIGHT SOURCE

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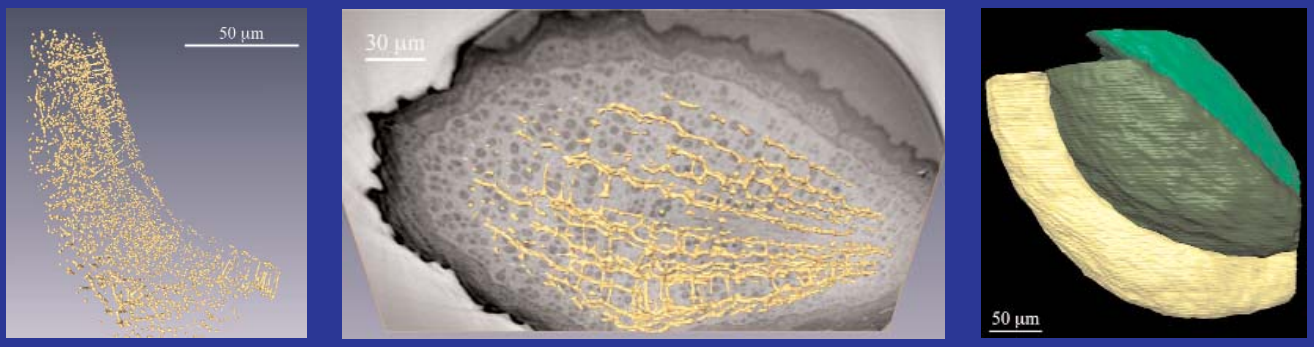
HIGH-RESOLUTION PHASE CONTRAST SR-BASED MICROTOMOGRAPHY REVEALS UNKNOWN AIR PATH IN SEEDS



A zoom on a section of one of the embryonic leaves showing the air channels acting as oxygen reservoirs in the seed. A zoom on a stem section showing a virtual section through the seed together with the void network and an X-ray image of a seed with the seed-coat virtually removed showing the embryonic leaves (green) and stem (beige).

Researchers from the CNRS, the UJF and INPG of Grenoble and the ESRF have shown, using the holotomography technique, that there is a void network within seeds that may be used for oxygen storage needed for efficient germination.

An interdisciplinary scientific team, with both biologists and physicists, used hard X-ray-based quantitative phase tomography to obtain three-dimensional images of an arabidopsis seed. This seed is a model plant for biologists, and the first one whose genome was sequenced. The used imaging approach, holotomography, is the only available technique with the penetration capacity and imaged field size suited for an investigation at sub-micrometer resolution of an optically opaque object the size of a seed. It is applied for the first time to an autonomous living system, observed without object destruction, without staining, in air, and at room temperature.

Embryonic photosynthesis leads to the production of seed-internal oxygen that is important for seed development and quality. In order to visualize seed-internal structures that could serve for oxygen storage, conventional methods are not appropriate, because they imply cutting the seed, thus leading to air escape. On the other hand, the ESRF allowed scientists to get the full picture of a seed without any modification of its structure.

Researchers identified individual cells clearly throughout the seed volume and rendered them in their three-dimensional organization. They also distinguished an intercellular air network, which should represent an important circulation system for air and perhaps water during germination. The discovery of such a void network opens the field of new research linking embryonic photosynthesis and the structure of the mature seed, in relation to seed quality, i.e. the capacity and vigour of germination.

However, at the present stage it is not yet possible to assure that this is the path the oxygen follows to "feed" the seed. A better resolution is required ("nano-imaging and analysis") to go further. These techniques are not available yet, but constitute an important part of the Long Term Strategy program the ESRF is presently elaborating.

P. Cloetens, R. Mache, M. Schlenker, S. Lerbs-Mache, Quantitative phase tomography of Arabidopsis seeds reveals intercellular void network, PNAS (2006) 103: 14626-14630.

EVENTS

The next **ESRF Users' Meeting** will be held on February 2007 on site at the ESRF in Grenoble. Three satellite workshops will be organized around it, on 6, 7 and 8 February.

The 2007 Users' Meeting will be largely devoted to the presentation and discussion of plans for the Long Term Strategy for the facility. These will include detailed projects both for beamlines, and for upgrades to the machine.

For more information, have a look at http://www.esrf.fr/events/announcements/esrf-users-meeting-2007-and-associated-workshops

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