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Subject: results of the inspection of different ship-timbers from the Ria de Aveiro F shipwreck (Portugal)

RING briefrapport number: 2010016

Amersfoort, 19 August 2013

Dear Mr. Coelho,

Hereby we inform you about the results of the inspection and pre-research carried out in several timbers of the shipwreck *Ria de Aveiro F*.

As none of the timbers were suitable for dendrochronological research, we just present the results of the wood identification.

Your sincerely,

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Inspection and wood-species identification of ship-timbers from the *Ria de Aveiro F* shipwreck (Portugal)

By Marta Domínguez Delmás

Ring Foundation (Stichting Ring) Netherlands Centre for Dendrochronology

Introduction

The facilities of the *Divisão de Arqueologia Náutica e Subaquática, Instituto de Gestão do Património Arquitectónico e Arqueológico* (DANS/IGESPAR) in Lisbon (Portugal), store numerous ship-timbers from different shipwrecks that have been excavated in this country in the past decades. In the context of the Iberian Heritage Project¹, Nigel Nayling (University of Wales Trinity Saint David, Lampeter, UK) and Marta Domínguez Delmás (RING Foundation – Netherlands Centre for Dendrochronology/Cultural Heritage Agency of the Netherlands, Amersfoort, NL) visited the DANS in October 2010 to inspect their collection. The ultimate goal was to identify and sample timbers with sapwood and/or sufficient growth-rings for dendrochronological research, in order to create a dataset of suspected Iberian tree-ring series that would eventually contribute to develop reference chronologies for the Iberian Peninsula.

Among the inspected shipwrecks were the remains of the *Ria de Aveiro F*.² Through visual inspection of several planks from this wreck, it was immediately concluded that they were of some diffuse porous species, i.e. with the pores or vessels distributed across the entire ring-width (**Schweingruber, 1990**). We decided to sample some of those planks, together with smaller fragments from other elements, in order to identify their species and assess their suitability for dendrochronological research.

Methods

Cross-sections were manually sawn from one end on nine planks. Smaller fragments of approximately 2 cm³ were taken from two other elements, and a cross-section was cut from a barrel stave that had been found associated to the shipwreck remains. All samples were wrapped in plastic to prevent them from drying and labelled appropriately.

Once at the laboratory of the Ring Foundation, cube-shaped sub-samples of approximately 1cm³ were removed from all the samples using a Stanley knife. Thin slices were manually cut with razor blades from the transverse, radial and tangential sections of the sub-samples, in order to observe the micro-

¹ Project entitled “Filling in the blanks in European dendrochronology: building a multidisciplinary research network to assess Iberian wooden cultural heritage worldwide” (a.k.a. Iberian Heritage Project), funded by the Netherlands Organisation for Scientific Research (NWO) and hosted by the Cultural Heritage Agency of the Netherlands (Principal Investigator: Marta Domínguez Delmás). Part of this project aimed to identify ship hull-assemblages in or (expected to be) from Iberia which might benefit from dendrochronological analysis and/or provide tree ring-width data to assist in the construction of long-span regional chronologies.

² Other inspected shipwrecks at the DANS included the *Arade 1* (Domínguez-Delmás et al., 2012), *Bracara Augusta* (Ring report number 2010087) and the *Ria de Aveiro G* (Ring report number 2010089PRAG).

characteristics of the wood anatomy of each sample (see <http://www.woodanatomy.ch/micro.html>, Schoch *et al.*, 2004). A transmitted-light microscope (Zeiss Axioscope40) coupled with a digital camera (Zeiss AxioCam MRc5) was used to visualize and photograph the key anatomical features of each sample. Two online resources were used for the wood identification: Wood Anatomy of European Species (<http://www.woodanatomy.ch/>, Schoch *et al.*, 2004) and the Inside Wood database (<http://insidewood.lib.ncsu.edu/search>, Wheeler, 2011).

Results

The barrel stave was found to be made out of chestnut (*Castanea sativa*) (**Table 1**), whereas the sample from an element that seemed to be made out of branch wood was identified as deciduous oak (*Quercus* subg. *quercus*). Chestnut is commonly spread in Europe, whereas different species of deciduous oak can be found in Europe and North America.

The nine researched planks resulted to be from the same tropical species. Anatomical features found in all these samples are listed in **Table 2** (see also **Appendix 1**). When running those features in the Inside Wood database, plus other features that were clearly visible in some of the samples (**Table 3**), we got results listing between 5 to 27 species from the taxonomic families Anacardiaceae, Lauraceae and Myristicaceae (**Table 4**). Species of these families are present in Central/South America, Africa and Asia.

Table 1. List of sampled timbers

Sample nr	Description	Wood type	Observations
RAVF 31	Branch wood	Deciduous oak	<ul style="list-style-type: none"> • Ring porous (tr) • Multiseriate medullary rays (tr, tg) • Flame-like pore groupings in latewood (tr) • 15 rings, no sapwood, no pith
RAVF stave	Barrel stave	Chestnut	<ul style="list-style-type: none"> • Ring porous (tr) • Uniseriate rays (tr, tg) • Flame-like pore groupings in latewood (tr) • Ca. 5 rings
RAVF 258	Hull plank, tangential	-	Not possible to identify; the subsample was too small and hard to prepare proper micro-slices
RAVF S/R 01	Plank, tangential	Tropical	<ul style="list-style-type: none"> • Diffuse porous • Marginal parenchyma bands not convincing • One row of upright cells in the rays (rd)
RAVF 115	Hull plank, tangential	Tropical	<ul style="list-style-type: none"> • Diffuse porous • One row of upright cells in the rays (rd)
RAVF 353	Hull plank, tangential	Tropical	<ul style="list-style-type: none"> • Diffuse porous • One row of upright cells in the rays (rd)
RAVF 354_10 RAVF 354_14 RAVF 354_16	Hull plank, tangential	Tropical	<ul style="list-style-type: none"> • Abundant radially clustered vessels (x2) (tr) • Oil cells apparent (rd) • Vessel ray pits big and simple • Plenty of septate fibres • Oil cells present
RAVF 416	Hull plank, tangential	Tropical	<ul style="list-style-type: none"> • Simple vessel parenchyma cells • Oil cells in axial parenchyma?
RAVF 420	Hull plank, tangential	Tropical	<ul style="list-style-type: none"> • Inter-vessel pits ca. 15µm • Oil cells present (tr) • One row of upright cells in the rays (rd) • Parenchyma in bands (rd) • Septate fibres present (tg) • Vessel ray pits simple (rd) • Vessel size ca. 100-200µm (tr) • 2/4 parenchyma strands (tr)
RAVF 3027	Tangential plank; timber from rear	Tropical	<ul style="list-style-type: none"> • Diffuse porous • One row of upright cells in the rays (rd)

Table 2. Anatomical features found in all the samples identified as tropical wood. Descriptions provided following the IAWA code according to Wheeler et al. (1989); p=present; a= absent; e= absent required

IAWA code	Description
1p	Growth ring boundaries distinct
5p	Wood diffuse porous
9a	Vessel grouping: vessels exclusively solitary (90% or more)
10a	Vessel grouping: vessels in radial multiples of 4 or more common
11a	Vessel grouping: vessel clusters common
13p	Simple perforation plates
22p	Intervessel pits (arrangement): alternate
27p	Intervessel pits (size): large (>10 µm)
31p	Vessel-ray pits with much reduced borders to apparently simple: pits rounded or angular
42p	Mean tangential diameter of vessel lumina c. 100-200 µm
56p	Tyloses common
61p	Ground tissue fibres with simple to minutely bordered pits
65p	Septate fibres present
79p	Paratracheal axial parenchyma vasicentric
92p	Axial parenchyma cell type/strand length: four (3-4) cells per parenchyma strand
97p	Ray width 1 to 3 cells
106p	Cellular composition rays: body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells
130e	Intercellular canals: radial canals

Table 3. Anatomical features found in some of the tropical-wood samples, in addition to the features listed in Table 2. Descriptions provided following the IAWA code according to Wheeler et al. (1989); p=present; a= absent; e=absent required

IAWA code	Description
89p	Axial parenchyma in marginal or in seemingly marginal bands
93p	Eight (5-8) cells per parenchyma strand
124e	Oil and/or mucilage cells associated with ray parenchyma
125e	Oil and/or mucilage cells associated with axial parenchyma
126e	Oil and/or mucilage cells present among fibres

Discussion

The most interesting information obtained from this research was the identification of planks made of tropical wood. The difficulty of narrowing down the species when dealing with tropical timbers has been presented in this report. If most of the hull was made with tropical wood, we could infer that the ship was built in some harbour from the European colonies that were established in tropical countries during the Age of Exploration and European expansion. However, given that only a small fraction of the hull-timbers were researched (and given that the absolute date for those or other ship-timbers has not been established by dendrochronological research), we cannot discard those planks as repairs.

The stave made of chestnut probably belonged to some barrel that served as container for food or liquid and that was transported on the ship. The oak sample belongs to an unidentified element. This hampers the possibility to extract much information from this piece of wood, illustrating the need to conduct a thorough registration of all individual timbers found at underwater archaeological sites.

Acknowledgements

We thank Francisco Alves for opening the doors of the DANS to us and allow us to inspect all ship timbers and to Joao Coelho and Pedro Neves de Oliveira for their kind assistance during the inspection of the timbers.

Table 4. List of species found for each search performed including different anatomical features observed in the tropical-wood samples. Descriptions provided following the IAWA code according to Wheeler et al. (1989); p=present; a= absent; e=absent required

IAWA codes	FAMILY and species
1p, 5p, 9a, 10a, 11a, 13p, 22p, 27p, 31p, 32p, 42p, 56p, 61p, 65p, 79p, 89p, 92p, 97p, 106p, 130e, with 0 allowable mismatches	<p>LAURACEAE</p> <p><i>Alseodaphne</i> spp.</p> <p><i>Aniba canelilla</i>, <i>A. ferrea</i>, <i>Aniba</i> spp.</p> <p><i>Beilschmiedia</i> sp.</p> <p>MYRISTICACEAE</p> <p><i>Staudtia stipitata</i> Warb.</p>
1p, 5p, 9a, 10a, 11a, 13p, 22p, 27p, 31p, 32p, 42p, 56p, 61p, 65p, 79p, 92p, 97p, 106p, 130e, with 0 allowable mismatches	<p>LAURACEAE</p> <p><i>Alseodaphne</i> spp.</p> <p><i>Aniba canelilla</i>, <i>A. ferrea</i>, <i>A. rosaeodora</i> Ducke, <i>Aniba</i> spp.</p> <p><i>Beilschmiedia</i> sp.</p> <p><i>Endiandra</i> spp.</p> <p><i>Phoebe posora</i></p> <p><i>Phoebe</i> spp.</p> <p>MYRISTICACEAE</p> <p><i>Staudtia stipitata</i> Warb.</p>
1p, 5p, 9a, 10a, 11a, 13p, 22p, 27p, 31p, 42p, 56p, 61p, 65p, 79p, 89p, 92p, 93p, 97p, 106p, 124e, 125e, 126e, 130e, with 1 allowable mismatch	<p>ANACARDIACEAE</p> <p><i>Comocladia</i> spp.</p> <p><i>Mauria heterophylla</i></p> <p><i>Pleiogynium</i> spp.</p> <p><i>Cryptocarya mannii</i></p> <p>MORACEAE</p> <p><i>Morus</i> spp.</p> <p>MYRISTICACEAE</p> <p><i>Endocomia macrocoma</i></p> <p><i>Endocomia rufirachis</i></p> <p><i>Myristica irya</i></p> <p><i>Staudtia stipitata</i> Warb.</p>
1p, 5p, 9a, 10a, 11a, 13p, 22p, 27p, 31p, 42p, 56p, 61p, 65p, 79p, 89p, 92p, 97p, 106p, 124e, 130e, with 1 allowable mismatch	<p>ANACARDIACEAE</p> <p><i>Comocladia</i> spp.</p> <p>LAURACEAE</p> <p><i>Aiouea impressa</i></p> <p><i>Alseodaphne</i> spp.</p> <p><i>Aniba affinis</i>, <i>A. canelilla</i>, <i>A. ferrea</i>, <i>A. rosaeodora</i> Ducke, <i>Aniba</i> spp.</p> <p><i>Beilschmiedia</i> sp.</p> <p><i>Cryptocarya mannii</i></p> <p><i>Dehaasia</i> spp.</p> <p><i>Endiandra</i> spp.</p> <p><i>Licaria</i> subgrp. <i>Canella</i></p> <p><i>Licaria</i> subgrp. <i>Guianensis</i></p> <p><i>Licaria subbullata</i></p> <p><i>Mezilaurus itauba</i></p> <p><i>Nectandra saligna</i></p> <p><i>Nothaphoebe</i> spp.</p> <p><i>Ocotea globifera</i></p> <p><i>Ocotea glomerata</i></p> <p><i>Ocotea nigra</i></p> <p><i>Ocotea guianensis</i></p> <p><i>Ocotea schomburgkiana</i></p> <p><i>Persea raimondii</i></p> <p><i>Phoebe posora</i></p> <p><i>Phoebe</i> spp.</p> <p><i>Pleurothyrium</i> spp.</p> <p><i>Ravensara aromatica</i></p> <p><i>Ravensara crassifolia</i></p> <p><i>Ravensara ovalifolia</i></p> <p>MYRISTICACEAE</p> <p><i>Staudtia stipitata</i> Warb.</p>

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Appendix 1. Wood anatomical features

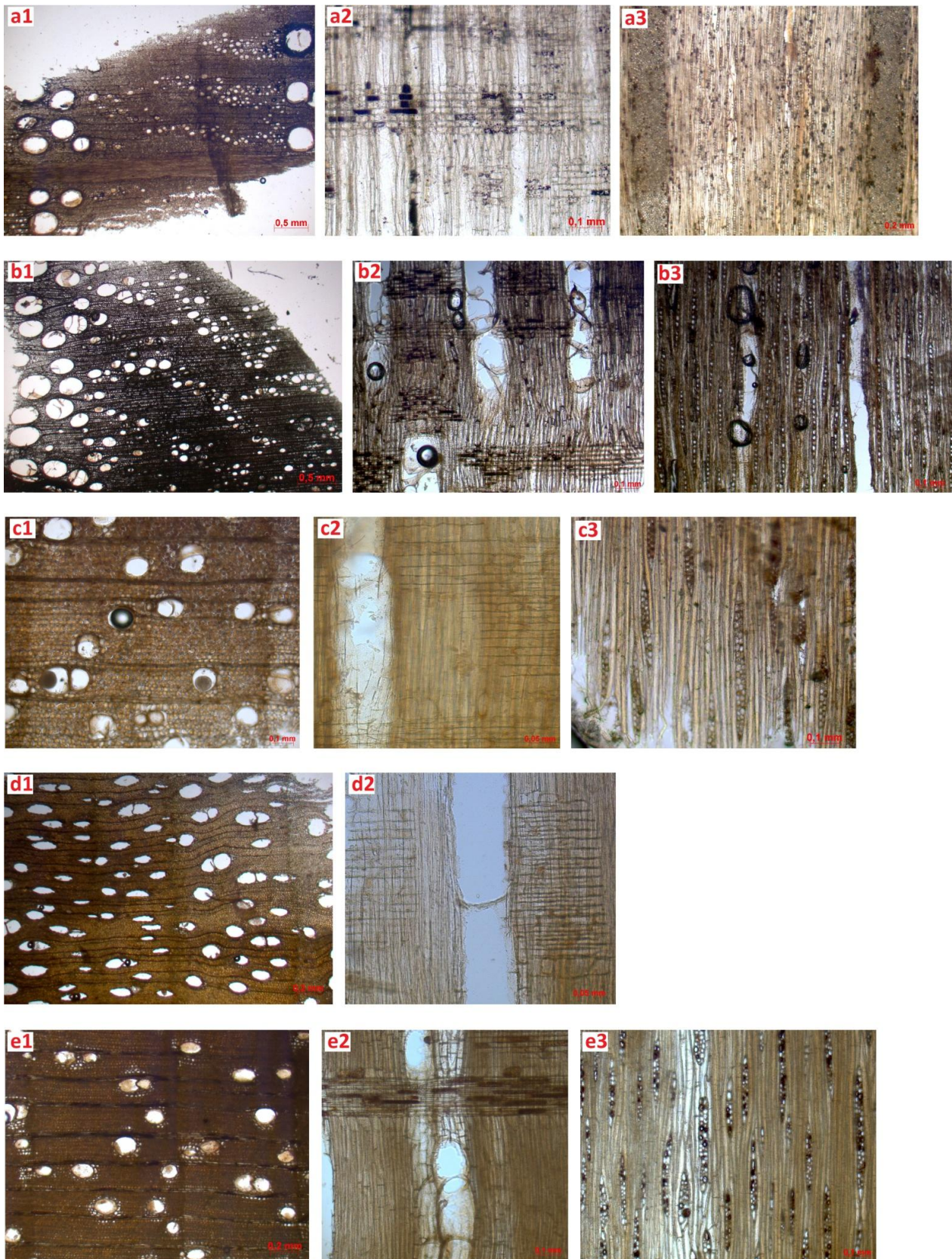


Figure 1. a) oak sample RAVF 31 (1, transversal section; 2, radial; 3, tangential); b) chestnut sample RAVF stave (1, tr; 2, rd; 3, tg); c) tropical wood sample RAVF S/R 01 (1, tr; 2, rd; 3, tg); d) tropical wood sample RAVF 115 (1, tr; 2, rd); e) tropical wood sample RAVF 353 (1, tr; 2, rd; 3, tg).

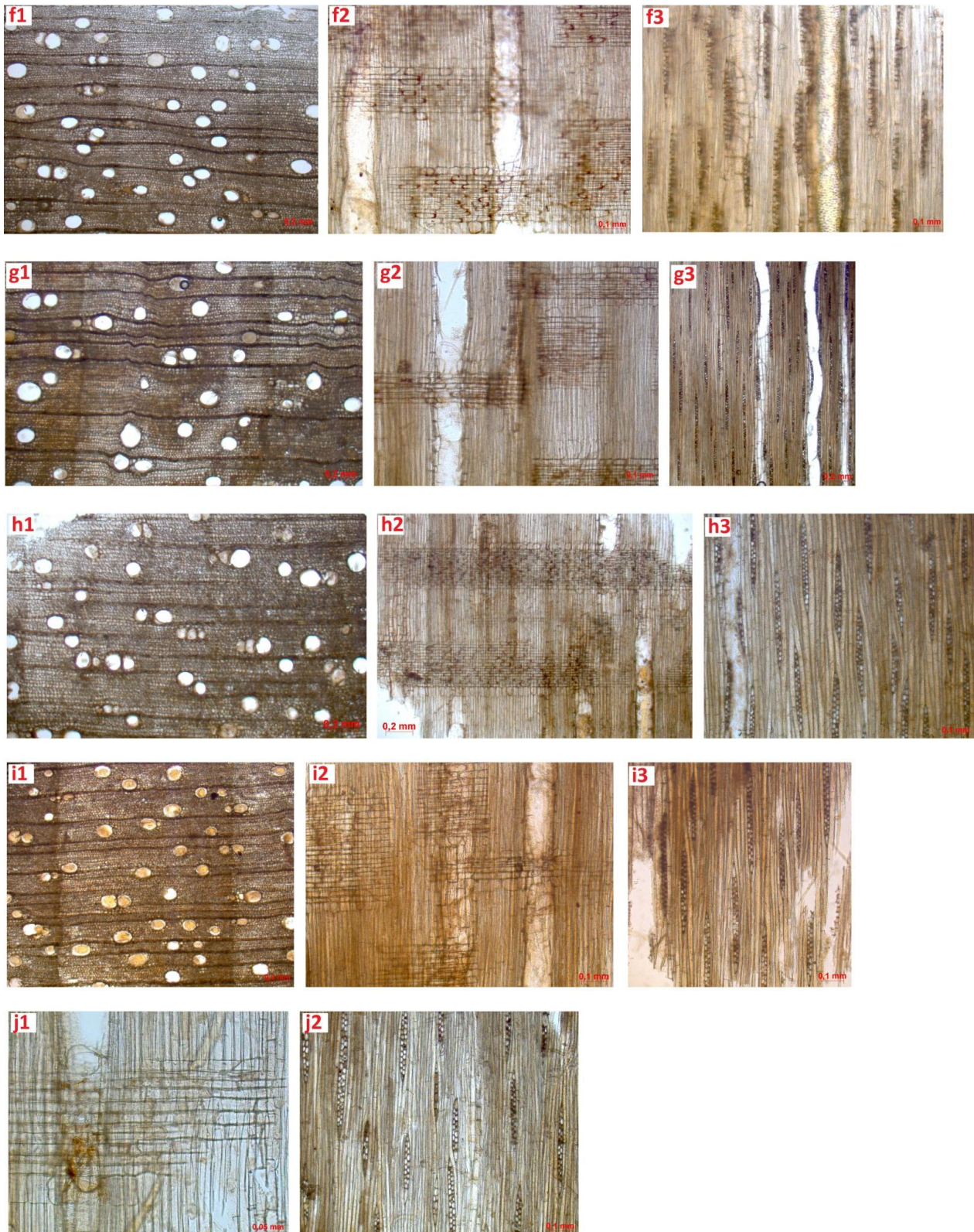


Figure 2. f) tropical wood sample RAVF 354_10 (1, tr; 2, rd; 3, tg); g) tropical wood sample RAVF 354_14 (1, tr; 2, rd; 3, tg); h) tropical wood sample RAVF 354_16 (1, tr; 2, rd; 3, tg); i) tropical wood sample RAVF 416 (1, tr; 2, rd; 3, tg); j) tropical wood sample RAVF 420 (1, rd; 2, tg).