

SOFT-TO-HARD BIOLOGICAL INTERFACES

MICROSTRUCTURAL AND MICROMECHANICAL INVESTIGATION OF THE TENDON-BONE ATTACHMENT

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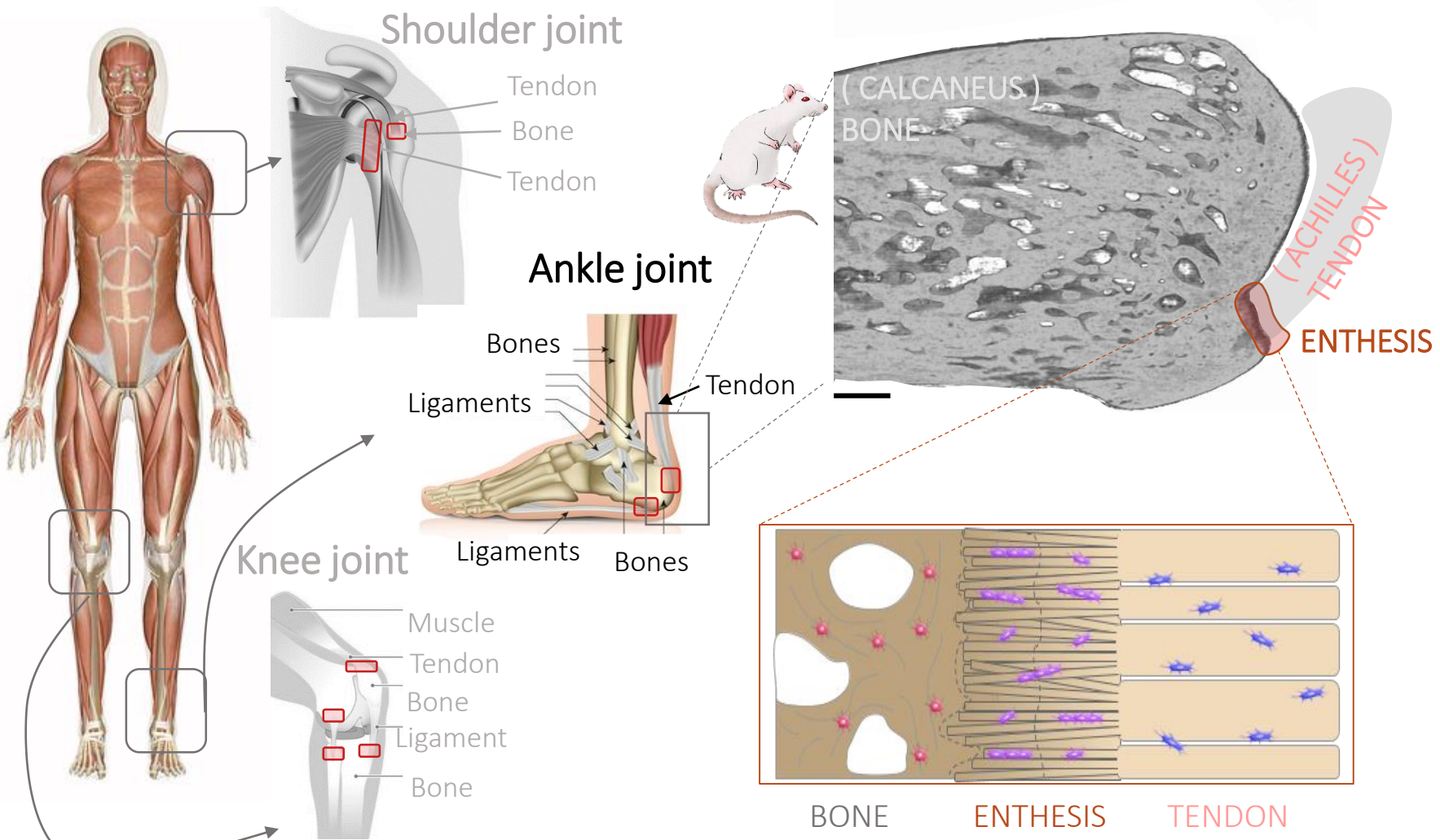
Mechanics of Biological and Bioinspired Materials
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D Ruffoni



INTRODUCTION

Entheses: where tendons and ligaments meet bone



WP1
Image analysis:
Microarchitecture

WP2
Mechanical testings:
Material properties

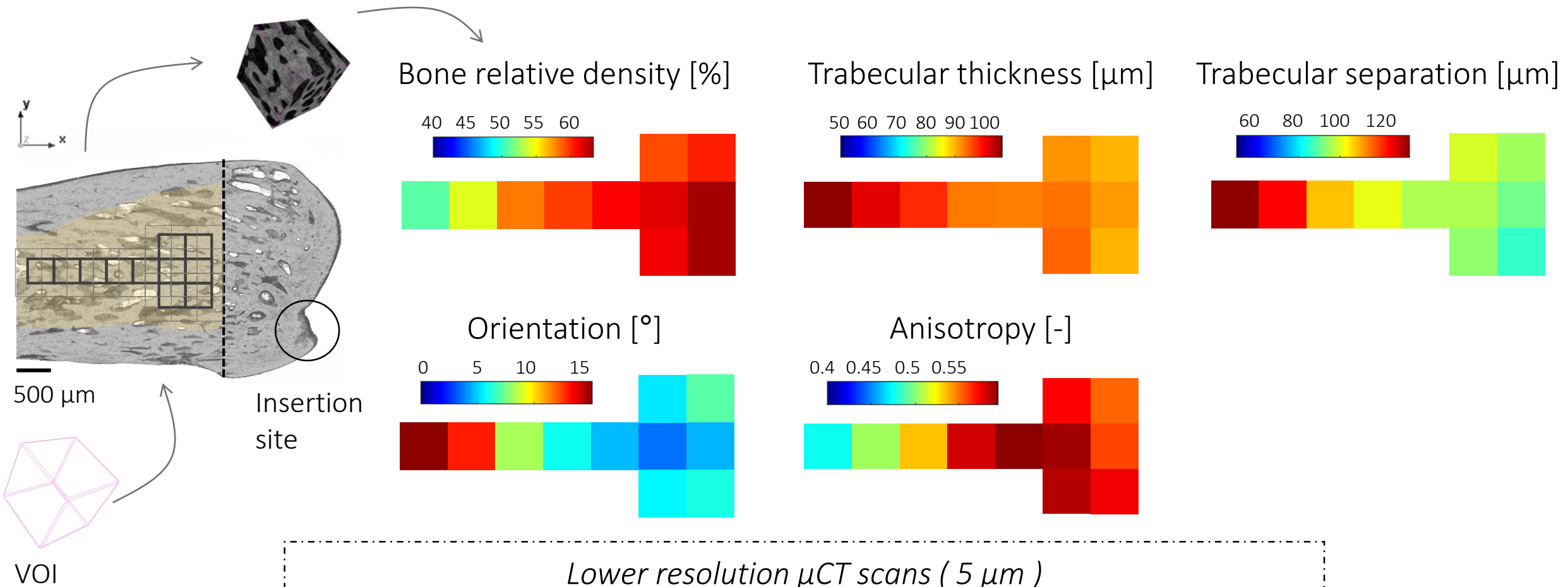
WP3
Computational model:
Mechanical analysis

CHARACTERIZATION

MODELLING

WP1: TRABECULAR MICROARCHITECTURE

Bone architecture adaptation to tendon insertion

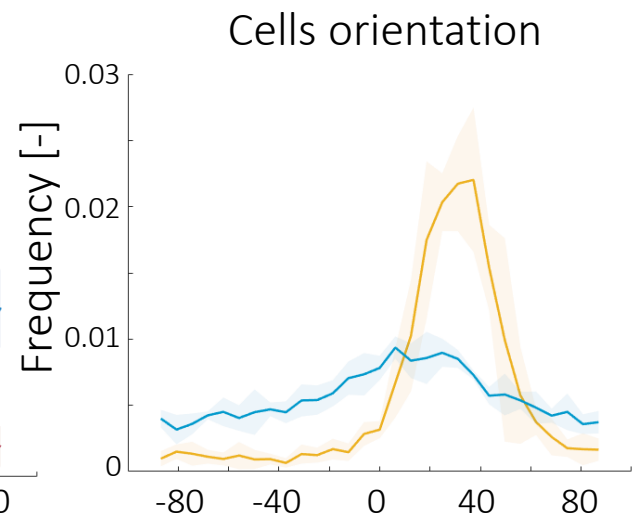
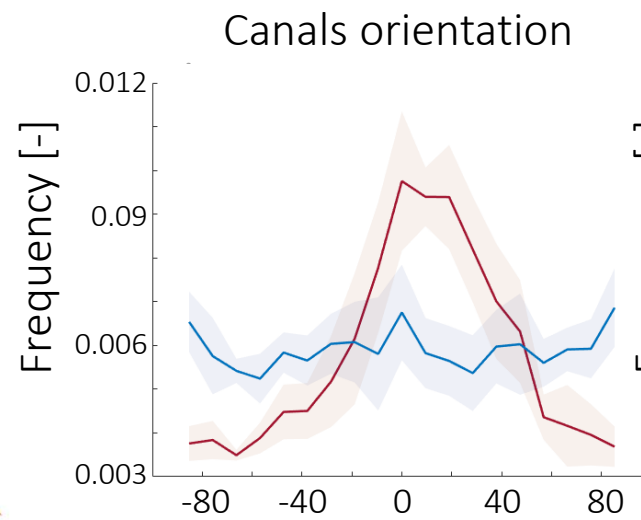
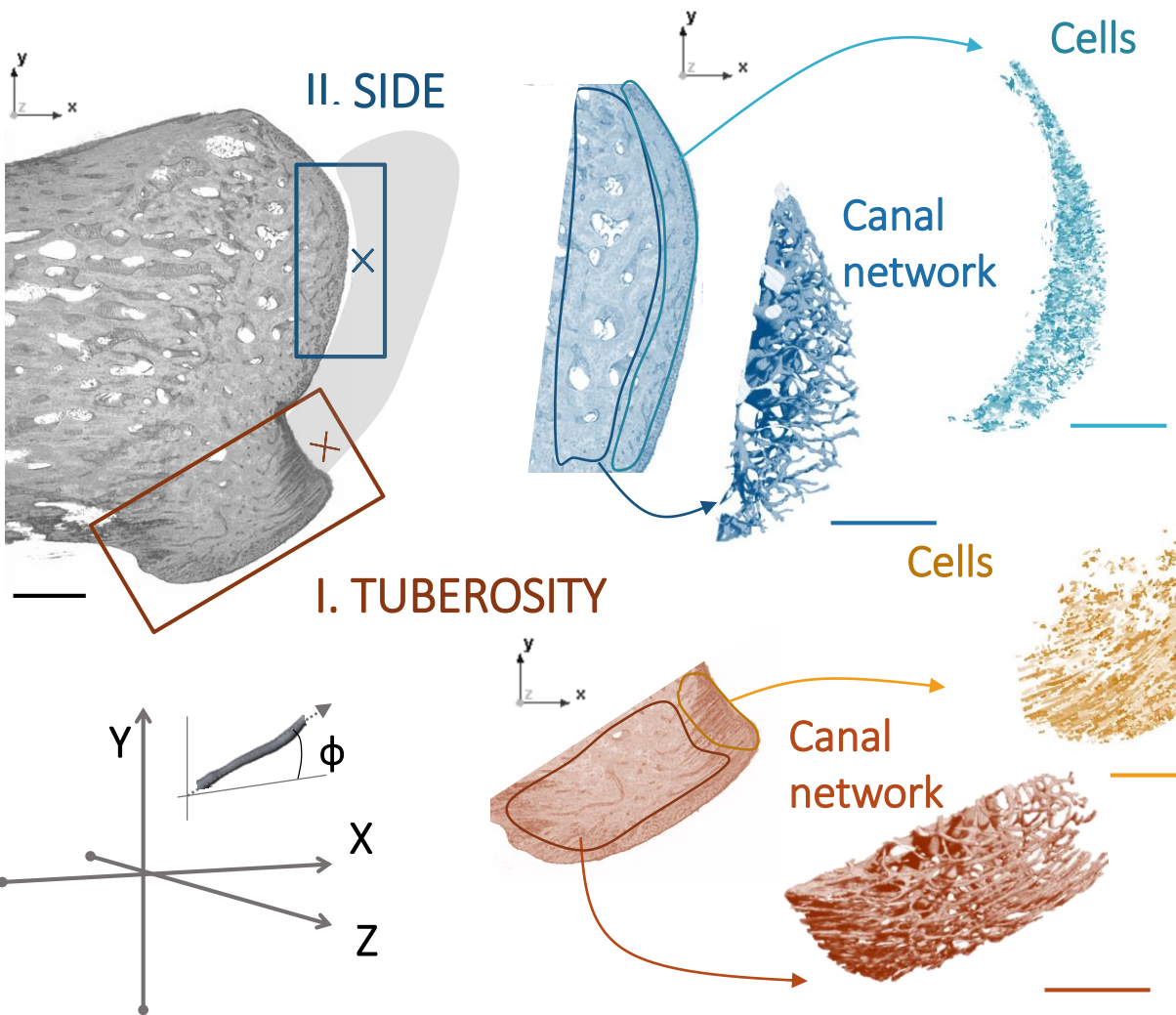


Lower resolution μCT scans (5 μm)
Trabecular network is not significantly influenced by the tendon insertion

WP1: CANAL & CELLULAR MICROARCHITECTURE

Bone architecture adaptation to tendon insertion

Erwan Plougouven, Belgium



Higher resolution μ CT scans (1.25 μ m)
Common predominant orientation in the range 20-30°

Scale bar: 500 μ m

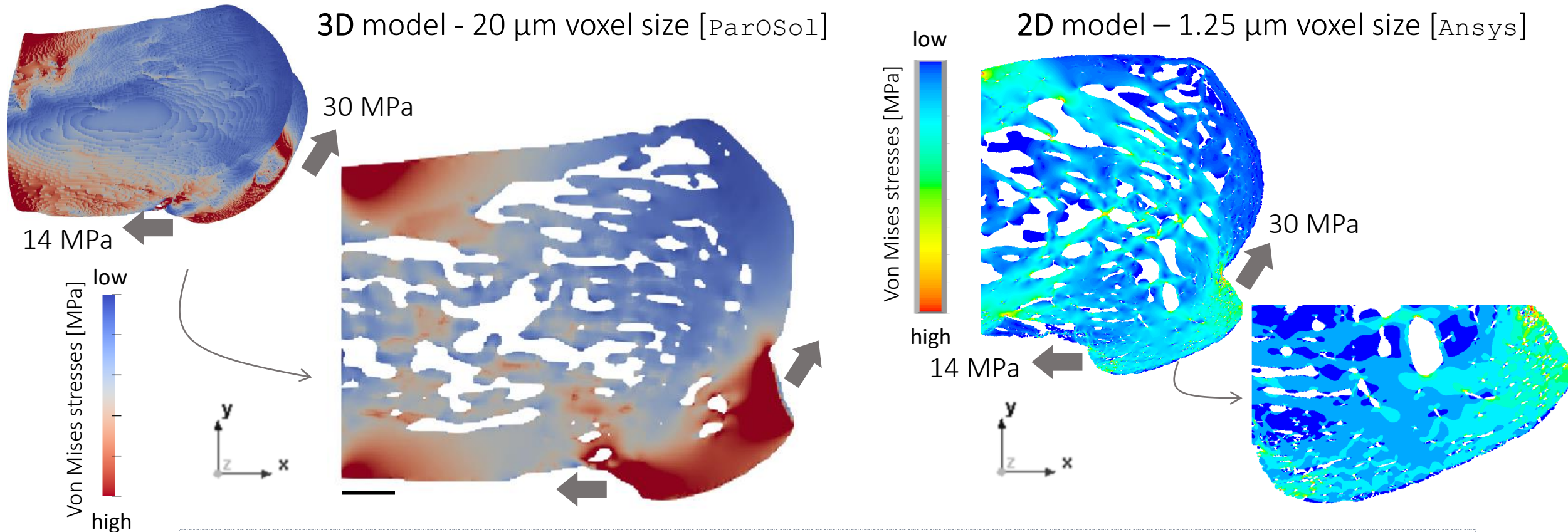
WP3: MECHANICAL ANALYSIS

Bone stresses induced by tendon loading

Peter Varga, Switzerland
Tim Volders, Belgium

ECTS
European Calcified Tissue Society

GEMSTONE
Genomics of Musculoskeletal
Tissue Translational Network



High stresses flow mainly within the tuberosity
Non trivial stress pattern within the bone and around porosity



CONCLUSION & OUTCOMES

What next ?



WP1

Image analysis:
Microarchitecture



μCT scans:
Predominant orientation of canal network and cell aggregates



Max Planck Institute
of Colloids and Interfaces

Confocal laser scanning microscope:
Osteocyte lacuno-canalicular network at the insertion?



WP2

Mechanical testings:
Material properties



Backscattered imaging:
Gradient in mineral content ?



Ludwig Boltzmann
Institute
Osteology

Nanoindentation:
Gradient in local mechanical properties ?



WP3

Computational model:
Mechanical analysis



Finite Element simulations:
Non trivial flow around bone porosity

Effect of the mineral content & mechanical properties gradient ?

