

Biom mineralization and strength of calcium carbonate cements

J. RODRIGUEZ-SANCHEZ^{1*}, B. MYSZKA², D.K. DYSTHE¹
AND A.R. BOCCACCINI²

¹Physics of Geological Processes, Department of Physics,
University of Oslo, PO Box 1048 Blindern, Oslo, Norway
(*correspondence: j.r.sanchez@fys.uio.no)

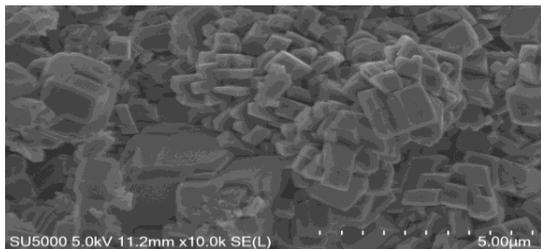
²Institute of Biomaterials, Friedrich-Alexander Universität
Erlangen-Nürnberg, Cauerstrasse 6, Erlangen, Germany

Calcium carbonate (CaCO_3) cement has emerged in the last few years as an attractive candidate for bone filling and reinforcement. Pure CaCO_3 cements were first reported by Fontaine *et al.*[1]. They exhibit a higher resorption rate in comparison with calcium phosphate (CaP) cement, the most widely used alternative so far.

In the present study we evaluate the bone bioactivity of CaCO_3 cements, i.e. their bone-bonding aptitude. Checking the ability of apatite to form on their surface when soaked in simulated body fluid (SBF) is a prevalent method [2]. The degree of apatite precipitation in SBF can predict the bonding extend at “in vivo” conditions. The study covers different periods of time (1, 3, 7 and 28 days) after which mechanical properties and degree of precipitation are measured. We quantify the increase in strength and increase in precipitation with time and compare to diffusion limited and reaction limited models.

Dried amorphous calcium carbonate (ACC) and vaterite (V) powders are also mixed in different ratios with deionized water. We find a corresponding change in microstructure and strength. A final variation of the cements is the inclusion of octanoic acid. These organic molecules are shown to affect the microstructure and strength. We compare these results to recent evidence that organic molecules play an important role in controlling recrystallization of mineral aggregates [3].

Figure 1: Hardened pure CaCO_3 cement, 1:2 ACC/V ratio.



- [1] M.L. Fontaine *et al.* (2005) *Key Eng. Mater.* **284–286**, 105–108 [2] T. Kokubo *et al.*(2006) *Biomaterials* **27**, 2907–2915 [3] T. Hassenkam *et al.* (2011), *Proc. Natl. Acad. Sci.* **108**, 8571–8576