Exploration of interactions involving human tooth enamel and dental composites using vertical scanning interferometry

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Although methacrylate resin-based dental composites are now used in the restoration of ~70% of the 120 million cavities (carious lesions) treated every year in the US, these materials have a limited service-life, requiring replacement after less than ~6 years (40% of a conventional amalgam). This replacement is most commonly necessitated because of secondary caries. Although the origin of these lesions at resin composite restoration sites is as yet unclear, they may be localized by leakage via microgaps between the cavosurface wall and the restoration. These microgaps result from shrinkage accompanying acrylate polymerization, thus yielding a protected microenvironment for growth of oral flora and subsequent chemical attack of the tooth (hydroxyapatite dissolution), and possibly the resin as well.

We present preliminary experimental results using restored teeth analyzed by vertical scanning interferometry (VSI, Fig. 1). VSI allows precise quantification of the geometry of the microgap environment and changes developing therein. Although the distribution of microgap volume is heterogeneous, the data clearly reveal the potential for micro-environments. Ongoing experiments include analysis of the chemical and mechanical response of these materials to imposed thermal and mechanical stresses, and *in vitro* analysis of microbial populations and attendant biofilm development.

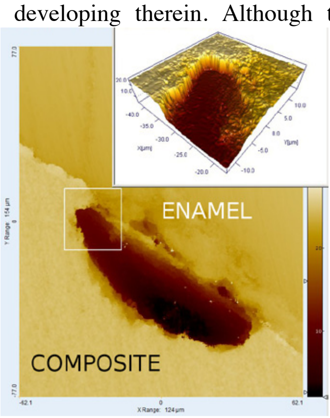

Figure 1: Microgap development at tooth-composite boundary.

Grain-supported flow at magma transfer zones

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Before extruding in volcanic systems, magma suffers a continued evolution during ascent from its source. Fingerprints of this magma transfer through the lithosphere are recorded by microstructures and textures in plutonic rocks.

At the most internal parts of the Variscan chain, high-K plutonic suites were emplaced following the roots of the orogen [1]. This singular high-K and Mg association of rocks (vaugnerites, appinites, redwitzites or durbachites) is related with vertical extrusion of lithosferic-mantle derived, high-K and Na melts [2, 3].

A widespread feature of these high-K suites is the development of sphene-centred ocellar textures in some synplutonic intrusions affected by mingling processes. The structural and petrological study of these textures indicates that they formed as an effect of Reynolds dilatancy in highly crystallised crystal mushes affected by grain-supported flow [4]. Fabrics deduced from field and ASM studies indicate oblate strain and compressive regime. These conditions favoured the vertical movement of hyperdense crystal mushes with non-newtonian behaviour. The strain partitioning in these magma transfer zones will promote melt migration to upper structural levels. Moreover, it will enhance the mingling process, fauvoring the large lithological variation observed in these suites.

[1] Ferre & Leake (2001) *Lithos*. [2] Janousek & Holub (2007) *Proc. Geologists' Assoc*. [3] Lexa *et al*. (2011) *J metam Geol* [4] Vegas *et al*. (2011) *J Geol*.