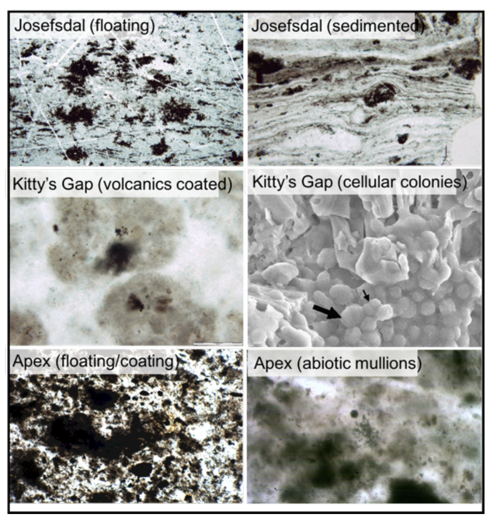
CHEMOTROPHIC BIOSIGNATURES IN CLOTTED CARBONACEOUS CHERTS. Keyron Hickman-Lewis[1,2], Barbara Cavalazzi[2] and Frances Westall[1]. [1]CNRS Centre de Biophysique Moléculaire, Orléans, France (keyron.hickman-lewis@cnrs-orleans.fr), [2]Università di Bologna, Bologna, Italy.

Introduction: The terminology "clotted carbonaceous chert' (CCC) has long been used for the Archaean black and white cherts described herein[1]. Specifically, a CCC is a granular chert, composed of silt- to sand-sized grains of carbonaceous material, which may contain relict sedimentary structures. Volcaniclastic and siliceous components are significant, respectively constituting the black and white colouration of CCCs. These characteristics, together with the grain size range reported for clotted fabrics, 0.05-0.5mm, are of the range described in recent studies of the Josefsdal chert[2], Kitty's Gap chert[3,4], stratiform Apex chert[5], Hooggenoeg Formation[6] and Dresser Formation[7]. The nature of the protoliths for these formations is variable, though most appear to be shallow-water. All feature strong hydrothermal influence, and both the Josefsdal and Dresser cherts show nuances of subaerial emergence.

Occurrences: The carbonaceous matter, which is preserved in all cases by extremely rapid silicification, could have an abiotic or biological genesis, and in each formation presents different morphologies. In the *Kitty's Gap Chert*[3,4], clotted material occurs as thin coatings on volcaniclastic grains of up to 500µm in size which, when observed with SEM, is cloud-like, non-isopachous and irregular. These coatings are demonstrably cellular, and contain persuasive evidence of biogenicity, including cell division and lysis. In the *Josefsdal Chert*, clots occur both as rounded, 'sedimented' objects entrained within the layers of phototrophic microbial mats and as three-dimensional, spiky objects up to almost 1mm in size, which appear to float within hydrothermal silica[2]. Clot morphology is also varied in the *Apex* CCCs: although some spiky morphologies are noted, clotted textures usually occur as carbon-coated volcanic ash clasts[5]; the putative biogenicity of these coatings has yet to be assessed. Clotted textures in the Apex material are also produced by the growth of spherulitic silica mullions within pre-existing carbonaceous material: this creates a distended three-dimensional web of carbon punctured by spherical voids. Thus, though the carbon may be of biological origin, its redistribution into this texture is abiological[8]; such a process might involve hydrothermal silica overprinting biogenic carbon, since such abiotic textures are most common in the vicinity of hydrothermal vents. In the *Dresser Formation*, CCCs contain individual carbon-rich clots in addition to thin veneer-like coatings. Although these have been proposed as biogenic based on a microstructure-specific carbon isotopic fractionation[7], that conclusion is less than satisfactorily supported by the data: there is certain overlap between the carbon isotope fractionation in both clots and other miscellaneous carbonaceous microstructures. This may be chaotically redistributed organic carbon, similar to that of some hydrothermal Apex chert.

Biosignatures or Pseudosignatures?: CCCs thus appear to contain both carbonaceous biosignatures and pseudosignatures. It is only at the highest resolution of observation that such deceptively simple features reveal their true affinity. In stratiform cherts, they are a poorly defined facies, but the detection of definitive and putative biosignatures in at least three such horizons[2-5] necessitates their appraisal in the search for Earth's earliest life. The chemotrophic organisms which constitute definitive biosignatures within CCCs would prove an ideal, extremely primitive analogue microbial trace for which one should search in similar Noachian palaeoenvironments at the Martian surface. The resolution of imaging instrumentation in upcoming Martian payloads has sufficient resolution to detect the morphology of comparable carbonaceous clots (though not individual cells), but additional comparison against geochemical measurements by SEM, Raman, LA-ICP-MS and PIXE will assist greatly in determining their biogenicity.



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