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Gypsum Deposits Associated with the Whitehill Formation (Ecca Group) in the Steytlerville-Jansenville Area, Southern Karoo, South Africa

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The Steyterville-Jansenville gypsum field is one of South Africa's smaller deposits. It is covered by an average of 500mm of soil and has fine powdery gypsum bodies which are, on average, 37cm thick and contain an average of 65% gypsum – medium grade. The calcium and sulphate ions required to form the gypsum mineral (CaSO4•2H2O) are supplied by the Whitehill Formation shale which is carbonate and pyrite rich. The Early Ufimian (late Permian) Whitehill Formation (part of the Ecca Group, lower Karoo Supergroup) is, on average, 30m thick with a debateable carbon content up to 14% C. The lithology is split into 'deep-water' facies and 'shallow-water' facies. The former consisting of chert and carbonate concretions while the latter has silty horizons, carbonate beds, but no chert. This particular shale is undergoing close study with regards to its potential to supply gas energy, but must also be recognised for its other economic benefits.

In South Africa, gypsum forms mainly near the surface in clay, in veins or as powders in discontinuous horizontal layers. Prerequisites for gypsum formation include the supply of calcium and sulphate to a zone of weathering, restricted drainage such as a pan, a clay layer in the drainage area and an arid climate where evaporation exceeds precipitation. The area of Klipplaat, Eastern Cape, in the Great Karoo meets these requirements and Pretoria Portland Cement (PPC) have mined gypsum from a weathered zone of the Whitehill Formation shale. Gypsum grades vary greatly from below 40% CaSO4•2H2O to well over 70% CaSO4•2H2O, and seem to be affected greatly by the degree of weathering as well as their topographical position.

The folding and faulting of the shale provide the weaker, more penetrable region in which gypsum is able to precipitate. Folding of the shale occurs as a series of large-scale and small-scale anticlines and synclines striking from East to West. Pyrite should be concentrated in the fold axis (weakest point) and this is where the larger gypsum deposits are found. Small, iron-rich layers are overlain by small lenses of gypsum and this suggests a relationship whereby Iron (II) Sulphate, combined with Calcium Carbonate, produces Calcium Sulphate (gypsum) and is reduced to Iron (III) Oxide which remains as these iron-rich layers.

Carbonate concretions up to 5m in length and 3m in width are common in the study area and literature suggests that they are associated with the deposition of the shale whereby calcium-rich nuclei grow in a concentric fashion during a non-depositional period. This period is also associated with a higher pyrite phase and this could explain the connection between the concretions and a higher gypsum zone within the Whitehill Formation. It is also possible that organic carbon is concentrated in and around these concretions and this could provide 'pockets' of higher carbon content within the Whitehill Formation where shale gas might be trapped at depth.

Primary author: Mr ALMANZA, Roberto (Nelson Mandela Metropolitan Univeristy)

Presenter: Mr ALMANZA, Roberto (Nelson Mandela Metropolitan Univeristy)

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