

Permo-Carboniferous sediments: Implications for paleolandscape evolution, climatic changes and geochemical exploration in the Yilgarn Craton, Western Australia

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Permo-Carboniferous continental glacial sediments cover large mineralized areas in the NE of Yilgarn Craton, Western Australia. They consist of polymictic diamictites of glacial outwash origin and glacio-lacustrine mudstones. Paleolandscape and paleoclimatic evolution indicate that these sediments were mechanically weathered and eroded from basement paleohighs of several provenances under an arid and cold climate. The resultant sediments filled disconnected, highly irregular, asymmetrical and poorly-drained basins.

By the end of Paleozoic, deep chemical weathering under a warm and humid climate and oscillation of the paleo-water table subdivided the Permo-Carboniferous sediments into three main chemostratigraphic units; 1) the lower unit (Unit I) composed of unweathered grey, calcareous and sulphide-rich sediments formed below the water table under anoxic and alkaline pH conditions; 2) the middle unit (Unit II) composed of slightly weathered brown ferruginous sediments formed under slightly alkaline and redox conditions; and 3) the upper unit (Unit III) composed of deeply weathered bleached kaolinitic clay formed under circum-neutral and oxidizing conditions.

Textural relationships, heavy minerals and chemical composition of the Permo-Carboniferous sediments indicate that they are derived from proximal provenances and thus can be used as a footprint to target proximal, buried mineralization.

Sampling strategy of these sediments should focus on two main interfaces between chemostratigraphic units that may reflect the spatial and temporal mechanical and hydromorphic dispersion of pathfinder elements. These include: 1) sulphide-rich basal conglomerates which represent the key physical interface separating the Permo-Carboniferous sediments from the underlying unweathered basement; 2) The regional chemical interface between the lower and middle units, along which redox-sensitive elements were enriched with iron and manganese oxides. These elements are released as a result of oxidation of sulphide and alteration of ferromagnesian minerals.