

Mineralogy of the Dillinger sandstone, Kimberley area, Gale Crater, Mars

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MSL Curiosity investigated the Dillinger sandstone outcrop, in the Kimberley area of Gale Crater, as the centrepiece of a campaign to understand sediments beneath the 'Bradbury Rise' unit on which Curiosity landed. A sample of the sandstone, "Windjana," was drilled, sieved, and delivered to the CheMin X-ray diffraction instrument. In CheMin, Co-K X-rays pass through a sample (which is vibrated to granular flow), and collected with energy discrimination by a cooled CCD camera to produce a 2D diffraction pattern, which is integrated to yield a 1D pattern.

The minerals in the Windjana sample are typical for slightly altered basalt: olivine (Fo₅₀₋₇₀), augite (Wo₄₂En₃₈Fs₂₀), pigeonite (Wo₀₂En₆₅Fs₃₂), opx (En₄₀Fs₆₀), alkali feldspar, magnetite, and pyrrhotite. Alteration phases include phyllosilicates, amorphous material, anhydrite and akaganeite. Windjana is unusual in its large proportions of augite, alkali feldspar and magnetite (17%, 16%, & 13% mass). The feldspar is sanidine, Or₈₀₋₁₀₀, based on its 'b' and 'c' cell parameters. The 'a' cell parameter in magnetite is somewhat lower than ideal stoichiometric, suggesting solid solution with maghemite. The bulk composition shows high K₂O and FeO_T but low Na₂O (3.1%, 27.9%, & 1.0%). By mass balance, the amorphous component must contain significant K₂O (>1.4%).

The mineralogy suggests the Dillinger Ss must represent multiple basaltic sources, because sanidine-rich igneous rocks do not contain low-Ca pyroxenes (except as xenoliths). The augite and sanidine are likely to represent a potassic igneous rock (like trachybasalt), while the low-Ca pyroxenes could represent 'tholeiitic' rock like the source(s) of earlier analysed samples (John_Klein & Cumberland). Or, the alkali feldspar could be diagenetic after original 'tholeiitic' basaltic sand. In either case, the magnetite, phyllosilicates and amorphous material would be ascribed to diagenesis *in situ*.