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The chemistry of fluvial sediments analyzed by the Curiosity rover

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The Curiosity rover has encountered a diversity of sedimentary rocks, which overall have displayed significant variations in both texture and composition. Early observations by the Curiosity rover in Gale crater revealed isolated outcrops of cemented pebbles and sand grains with textures typical of fluvial sedimentary conglomerates (Williams et al., Science, 2013). Sandstones and mudstones, interpreted as having been deposited in a fluvio-lacustrine environment, were observed at Yellowknife Bay, a location identified from orbital images as of significant interest (Grotzinger et al., 2014). More stratified sandstones have been observed in the second and third terrestrial years of investigation in the outcrops named Cooperstown, Kylie and Kimberley, and Pahrump. The different groups of sediments have been interpreted to represent fluvial transport across Gale crater (Grotzinger et al., AGU, 2014), but they show a high variation in their composition, especially at Kimberley where rocks display enhanced K proportion. Among sedimentary rocks, conglomerates provide the most direct knowledge of the source of sediments. Conglomerates observed by Curiosity contain clasts with a strong diversity in albedo and textures indicating multiple sources on the Gale crater rims, with local identification of minerals such as plagioclases and alkali feldspars. Assuming the conglomerates are a mechanically altered product of crustal rocks with relatively little aqueous alteration, the average composition of conglomerates can be considered as a proxy for the source rock composition. This average composition displays a more felsic composition than the Martian average crust as defined by meteorites and orbital data implying that the Gale crater rim is enriched in felsic rocks. The difference in sedimentary composition suggests a variability in source rocks and/or diagenetic evolution compared to the conglomerates that needs to be considered in the broad context of Gale crater's evolution.