Processes that control mineral and element abundances in shales

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Abstract––A shale's composition can be used to infer physical, chemical, and biological processes that have acted on it over its life history and this knowledge is used to surmise conditions at the time when each process was active. This review lists the most important processes that control shale mineral and element abundances during each of the five stages of its life history. (1) During weathering, transport, and deposition, the most important processes are chemical weathering, hydraulic sorting and mixing, adsorption, reverse weathering, and incorporation of organic matter and biominerals. (2) During early diagenesis, the most important processes are exchange across the water/sediment interface, compaction, microbial respiration, mineral transformations, and concretion formation. (3) During burial diagenesis, the most important processes are compaction, catagenesis (and metagenesis), and mineral transformations. (4) During exhumation, the most important processes are decompaction, brine invasion, groundwater penetration, and microbial respiration. (5) During weathering, the most important processes are organic matter oxidation, mineral oxidation and hydrolysis, groundwater transport, and disaggregation. This classification of processes provides a way to envision how concurrent and consecutive processes that occurred over a shale's life history have affected its mineralogy and chemical composition.

Key words: shale; geochemical processes; mineral abundance; element abundance