PP33E-0593 Preliminary insights on evaluating paleosol composition from automated mineralogy analysis

Wednesday, 11 December 2024
13:40 - 17:30
Hall B-C (Poster Hall) (Convention Center)

Abstract

Advancements in automated mineralogy offer an opportunity to develop new approaches to the study of fine-grained sedimentary lithologies including paleosols and pedogenic minerals that hold valuable paleoclimate information. Automated mineralogy is a non-destructive analytical technique that relies on BSE imaging with spectral data to output multimodal hypermaps. Spatial domains are delineated and assigned mineral phases using whole spectrum best matching to reference spectra, providing quantitative sample composition estimates with high throughput data collection. We targeted a Spodosol in the lower part of the Upper Pennsylvanian Casselman Fm. of the Appalachian basin to evaluate the utility of automated mineralogy in determining paleosol composition. During deposition of the lower Casselman Fm., tropical climate during the Late Paleozoic Ice Age began a return to a more humid regime following the Kasimovian–Gzhelian boundary (~304 Ma) warming event. The Spodosol is a composite paleosol approximately 1.4 m thick that displays redoximorphic mottling, small scale (≤ 3 cm) slickensides and weak angular platy ped development. We performed automated mineralogy analysis on 9 paleosol samples, which were formed into 25 mm polished epoxy mounts of disaggregated peds, and generated complete mineralogical maps of the samples. These results indicate that phyllosilicate clays, mainly illite, formed the dominant mineralogic group (50-85%) with lesser amounts of quartz (~5-23%), feldspar (12-30%), carbonate (0-12%) and Fe-oxides (0-9%). Estimates of Al, Ca, Na and K from were used to determine Chemical Index of Alteration, with values ranging from 59-67. These CIA estimates tend to be quite low compared to CIA estimates determined from previous work using bulk elemental abundances by WDS-XRF (CIA >67). Further interrogation of these preliminary results revealed that interphase quartz-illite analyses were assigned a potassium feldspar interpretation. Ultimately we will combine image analysis (e.g., particle shape/habit) with new reference spectra for paleosol interphase matrix material, which together with WDS-XRF and XRD mineralogy calibration can be used to develop a robust methodology for automated mineralogy analysis of paleosols.

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