Abstract

High-chroma features have not been adequately defined under existing terminology or classified under existing systems. The terms "masses" as a subclass of concentrations used in field definitions and "loose infillings" used in micromorpological classifications come closest but are not fully satisfactory. Defined descriptively, high-chroma features have a typical color of 7.5YR 5/8, are usually less than 1 to 2 mm in diameter, are poorly cemented, and have a sharp external boundary with the soil matrix. They are found in well-drained to poorly drained soils with first-appearance typically at depths of 50 to 100 cm. A study was undertaken to more fully characterize and classify high-chroma features and to provide more accurate interpretations of feature morphology for applications in environmental and soil quality, plant nutrition, and soil genesis.

High-chroma features found within peds having varying degrees of hydromorphic expression were assigned to classes depending on internal color and color patterns. Material removed from features, halos, and the soil matrix was analyzed using a low-power stereomicroscope, SEM/EDS, TEM/ED, μ-XRD, ICP, and stain tests to determine properties and composition.

Four formation hypotheses are proposed: (1) a non-pedogenic origin, features having developed from the weathering of an inherited precursor mineral; (2) a pedogenic origin resulting from the formation and infilling of vesicles that formed at depth shortly after deglaciation but are no longer actively forming; (3) a pedogenic origin but features are actively forming; (4) formation by dissolution of a soluble mineral fragment and subsequent infilling of the resulting void, analogous to the formation of a geode.

Although high-chroma features might develop by more than one pathway, a non-pedogenic origin is favored. Non-pedogenic hypothesis (1) and the hybrid geodic hypothesis (4) offer the most efficient explanations for the presence of silt, iron, and manganese within high-chroma features. A proposed weathering sequence based on feature classification and evidence for the presence of manganese nodules in the till-source bedrock also support a non-pedogenic origin. Pedogenic hypotheses require a sequence of events of uncertain and in some cases seemingly low probability.

Existing classification systems offer little insight into genesis. Most importantly, given the evidence for a non-pedogenic origin, high-chroma features should not be interpreted or classified as redoximorphic features as the term is typically used in the field. Although high-chroma features may result from alternating periods of oxidation and reduction, when used alone they are ambiguous indicators of seasonal wetness.