

Relationships between weathering types and environmental condition - examples of caves and underground sites.

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Various microenvironments influence on types of weathering processes even in the same caves. This study introduce the weathering types of Yoshimi Hyaku Ana archaeological site in Saitama, the abandoned Oya tuff mine (Oya museum) in Utsunomiya and Taya Cavern in Josenji Temple in Yokohama. The tunnels in Yoshimi Hyakuana were excavated at the bottom of Yoshimi hill. Salt weathering due to sodium, potassium, iron and aluminum sulfates are observed at low humidity points near outside and sunny places. However, only calcium sulfate is observed even at the position near tunnel entrance just under the shade zone of the hill by trees and inside of the tunnel. Types of bedrock also provides important information. The abandoned Oya tuff mine has also been suffering from salt weathering, however, most of salts are sodium sulfate. The bedrocks of Yoshimi and Oya areas are both Miocene felsic tuff rich in aluminum, however, Yoshimi site produced highly acidic sulfates but not in the abandoned Oya tuff mine. Taya cavern does not show salt weathering but slaking (wetting and drying weathering) were observed. The bedrock type is early Quaternary sediment mixture with volcanic ashes. Strength is low and tunnel wall surface is suffering from exfoliation due to slaking. From these observation, it can be summarized that material type, environmental condition including groundwater are important to distinguish types of weathering processes.

Keywords: tunnel, salt weathering, slaking, wetting and drying weathering, sulfates, tuff