

Cannonball concretions of Northern Sabah, Malaysia

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Calcareous sandstone concretions are abundant in the Kudat Formation (Oligocene-Early Miocene) of Northern Sabah. They vary in size from small objects less than 1 cm in diameter to great spherical bodies metre-scale in greatest dimension. The field term cannonball concretion is applied to the larger spherical type. Calcareous sandstone concretion is the product of localized precipitation of mineral matter, mostly carbonate, in the pores of sediment about a nucleus such as organic material or rock fragment. The cannonball concretions occur mainly in the sandstone beds of the Tajau Sandstone Member of the Kudat Formation. They are exposed on cliffs and on shore platforms in coastal areas due to sea erosion. Boulders of dislodged concretions due to sea erosion also litter the coastal areas. Mudstone fragments usually occur as nuclei inside the concretions and they are critical elements in the formation of concretions as they act as nucleation areas. Most of the concretions are spherical, oval or elongated in shape and some are stained or capped with reddish-brown hard iron oxide crust. Sandstone concretions are geological objects with high geoheritage values. They contain a frozen record of the condition of the sediment at the time of deposition. They could provide scientific information on the orientation of past fluid flow in the host rock, local permeability trends, variation in groundwater velocity and the types of geological features that influence flow. They also have high aesthetic, cultural and recreational values. They are under potential threats of destruction due to vandalism, unregulated development, irresponsible specimen collection, inappropriate recreational activities and removal of objects and should be protected. The geoconservation measures include erecting 'no vandalism' warning signs, creating awareness and granting legal protection. Geosites with eye-catching sandstone concretions could be developed as geotourism destination. For this purpose, appropriate interpretation and basic infrastructures should be provided. There should be a smart partnership among stakeholders (local community, tourism industry and local authority) to ensure a successful geoconservation and geotourism development through proper planning and management of the site.