Map Unit Properties Table for Jewel Cave National Monument

Age	Map Unit (Symbol)	Description and Distinctive Features	Mineral Resources	Paleontological Resources	Suitability for Development/Recreation	Depositional Setting
QUATERNARY (Holocene and Pleistocene)	Alluvial deposits (Qal)	Mud, silt, sand, and gravel; maximum thickness 10 m (33 ft)	Gravel deposits	None documented	Local aquifer where saturated	Holocene streams
	Terrace gravel and alluvial-fan deposits (Qt)	Gravel, sand, and silt; maximum thickness 30 m (100 ft); some higher elevation deposits could be Pliocene age	Gravel deposits	None documented	Potential for landslides on north- and east-facing scarps	Pleistocene and Pliocene (?) streams
TRIASSIC PERMIAN	Spearfish Formation (ŦPs)	Red shale and siltstone, minor limestone and gypsum; collapse structures (limestone-dolomite breccias) produced by the solution of anhydrite in early Cenozoic; 70–275 m (230–900 ft) thick	Gypsum	None documented	Minor deformational structures (e.g., small thrust faults, minor folds, dolomite breccia, and pull-apart structures [in gypsum])	Low-energy environment; flat, hot desert plain near the ocean
PERMIAN	Minnekahta Limestone (Pm)	Pinkish gray, thin-bedded limestone; 10–18 m (33–60 ft) thick	High-purity limestone used for cement and lime; source of crushed rock, ballast, riprap, and building stone; calcite and anhydrite crystals	Pelecypod shells, gastropod casts, fragmentary fish remains, possible algal structures	Minor deformational structures (e.g., small thrust faults, minor folds, dolomite breccia, and pull-apart structures [in gypsum]); subsidence structures from dissolution of anhydrite; aquifer	Marine
	Opeche Shale (Po)	Red to maroon shale and siltstone; 20–40 m (66–130 ft) thick	None documented	None documented	Unknown	Probable inland playa setting
PERMIAN PENNSYLVANIAN	Minnelusa Formation (ℙm)	Maximum thickness in the southwestern Black Hills 183 m (600 ft), with only the lower 107 m (350 ft) present in the immediate vicinity of Jewel Cave; collapse structures (breccias) associated with dissolution of underlying cave passages up into lithified subunit I, occur in the upper Minnelusa, several miles south of the known passages of Jewel Cave Subunit VI: Brecciated sandstone (limestone and anhydrite), varicolored but often brilliant red; some interbedded limestone; ~37 m (120 ft) thick Subunit V: Varicolored sandstones (bright red and yellow, light tan); limestone near base weathers like upper dolomite of subunit IV; ~37 m (120 ft) thick Subunit IV: Interbedded dolomite, sandstone, with uppermost layer of dolomite; sandstones may be bright red and yellow in places; ~37 m (120 ft) thick Subunit III: ~37 m (120 ft) thick total; subdivided into IIIm: limestone cap, often very sandy, ~6–9 m (20–30 ft) thick; and IIIs: varicolored sandstone, often quartzitic; well-cemented gravel quartzite near bottom; ~24–27 m (80–90 ft) thick Subunit II: Limestone interbedded with sandstones, and shales; prominent chert near the top; limestone beds up to 0.6 m (2 ft) thick; clastic beds up to 15 cm (6 in) thick; overall thickness ~15 m (50 ft) Subunit I: Cross-bedded, varicolored sandstone at base; red siltstone and mudstone at top; ~12 m (40 ft) thick	Oil produced from lower part of formation south of Jewel Cave National Monument; sand used for glass manufacturing; accessory minerals in sandstone: zircon, tourmaline, leucoxene, carbonate, pyrite with anhydrite, and fluorite	Millipore fossils are a distinctive marker on the upper bedding surface of IIIm	Sandstone intervals are good aquifers but probably contain only minor amounts of water near Jewel Cave Extensive minor faults and folds, predominantly reflecting the structure of the underlying Madison (Pahasapa) Limestone	Fluvial sand; deltaic and estuarine sediments
MISSISSIPPIAN	Pahasapa Limestone (Mp)	Called "Pahasapa" where it outcrops in the Black Hills and "Madison" in the sub-surface (Mike Wiles, Jewel Cave National Monument, written communication, November 27, 2007) Gray, tan, brown, and white limestone and dolomite; surfaces of natural outcrops often stained bluish gray or red Thickest limestone layer in Black Hills (80–210 m [260–690 ft]); ~137 m (450 ft) thick in the vicinity of Jewel Cave Three equally thick subunits: (1) upper subunit—massive fossiliferous limestone; (2) middle subunit—prominently bedded limestone and dolomites, with thicknesses ranging from 10 cm (4 in) to 3 m (10 ft), capped with 3–4.5 m (10–15 ft) of interbedded chert and carbonates; (3) lowest subunit—massive, prominently fractured dolomite	Chert separates lofts from main level of cave; calcite spar lining in cave and many smaller cavities lined with calcite; has been mined for limestone and dolomite	Fossil shells (brachiopods); colonial corals primarily in the upper 76 m (250 ft)	Hosts nearly all Black Hills caves; Jewel Cave occupies upper 76 m (250 ft) of formation; forms steep-walled cliffs in canyons; regional aquifer but supplies no water in monument	Platform carbonate deposited in shallow sea; records multiple sea-level advances and retreats and periodic high evaporation

Age	Map Unit (Symbol)	Description and Distinctive Features	Mineral Resources	Paleontological Resources	Suitability for Development/Recreation	Depositional Setting
MISSISSIPPIAN DEVONIAN	Englewood Limestone (MDe)	Pink to lavender shaley limestone; 10–20 m (33–66 ft) thick	None documented	Uppermost 2.4 m (8 ft) highly fossiliferous	Unknown	Marine
ORDOVICIAN CAMBRIAN	Deadwood Formation (O€d)	Glauconitic sandstone, shale, siltstone, and conglomerate; up to 200 m (650 ft) thick	Silica	None documented	Upper 30 m (100 ft) serves as aquifer for Jewel Cave National Monument water supply Extensive minor folds and faults	Sand deposits carried to shallow sea by streams; represents nearshore deposition of a regressing sea
PRECAMBRIAN (Early Proterozoic)	Metagabbro (Xgb)	Predominantly sill-like bodies of dark-green amphibolite, actinolite schist, or greenstone; though not lithologically distinct, minor chemical differences in selected samples indicate at least two distinct types of different ages; highly variable thicknesses up to 305 m (1,000 ft)	None	None documented	Jewel Cave Fault Zone originates in Precambrian rocks and resulted in pronounced offset of escarpment	Igneous intrusion
	Distal metagraywacke (Xgwd)	Grayish tan, siliceous schist; maximum thickness 3,600 m (11,810 ft)	Garnet, staurolite, and sillimanite			Rapid erosion, transportation, deposition, and burial of original sediments (marine turbidites) and later metamorphism