ABSTRACT

TITLE:	Digital Cartography and a Preliminary Assessment of Morphology and Safety: Gallina Cave, Northern New Mexico
AUTHOR(S):	Bobb, Justin ; Kenny , Dr. Ray
PRESENTED AT:	4th Annual Natural & Behavioral Sciences Undergraduate Research Symposium, Fort Lewis College

ABSTRACT: Gallina Cave is a 479m (1570ft) long cave developed in the Middle to Late (~300 Ma), Pennsylvanian Madera Limestone. The cave is adjacent to a fault that juxtaposed the Pennsylvanian limestone with Precambrian granite. Locally, the Madera Limestone is a fossiliferous limestone with minor interbedded siliciclastics. Gallina Cave is a high elevation cave (2720m or 8920ft) with a perennial stream that follows the NW/SE trend of the cave (broadly correlative with the regional dip of the limestone) and emerges at the cave entrance. Reconnaissance cave surveys (from 1963 & 1993) were spot checked for accuracy and digitally reproduced along with previously unmapped cave passages discovered in the far reaches of the cave. The cave is located in the San Pedro Mountains (San Pedro Parks Wilderness Area, Santa Fe National Forest) of north-central New Mexico (UTM: 334,536 mE; 4,002,010 mN; Zone 13). Data collected from this study will be included in the National Forest Service Cave Management Plan for this area. Cave temperature and carbon dioxide (CO_2) levels were obtained as part of an initial safety assessment. Cave temperatures ranged from 7-11C (45-52F); CO_2 values ranged from (1800-2600ppm or 0.18-0.26%). The CO_2 values were obtained from upper and lower cave passageways, are within levels considered safe for cave exploration, and suggest that the cave has sufficient airflow to maintain relatively low CO_2 levels. Water samples, collected from surface streams, cave springs, and the cave stream, were analyzed for dominant cations to gain a basic understanding of the cave hydrology. Water samples were analyzed for Al, Ca, Mg, K, Si, and Na using Inductively Coupled Plasma, Optical Emission Spectroscopy. Ca was the dominant cation for all water sources (Mg was a minor constituent). Ca concentrations in the cave waters were elevated relative to surface waters (averaging 37ppm & 10ppm, respectively). Na and K were analyzed to test for hydraulic conductivity between the cave waters and the granite. No significant Na or K anomalies were observed; concentrations in all waters were low (averaging 2.7ppm & below 1.0ppm, respectively). The geochemistry reflects the limestone host bedrock, suggests that cave springs are not hydraulically connected to the granite, and the overall water chemistry can be explained by invoking typical carbonate dissolution processes associated with the development of smaller limestone caves. Fracture trends in the limestone were measured on the surface and compared to cave passage trends; the observed trends defined a conjugate pattern that aligned well with the main and tributary cave passages (mostly perpendicular to main passage). The fracture data suggest that the cave passages are mostly joint controlled. The morphology of the cave is noteworthy and distinctive. Northeast-trending tributary passages are filled with inactive and active speleothems and a few large flowstones; tributary passages entering from the opposing side of the cave are characterized by an absence of speleothems and the presence of unconsolidated siliciclastic material which is likely the result of active infiltration of surface water and old, currently inactive channels and paleo-infiltration sites.