Appendix GEO

Paleontological Technical Information

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Quaternary Young Alluvial Fan and Fluvial Deposits

Middle to late Holocene alluvial fan and fluvial deposits (Q, Qal), mapped extensively throughout the Geyserville, Guerneville, Larkfield, Graton, and Santa Rosa Potential Sites, are composed of unconsolidated to moderately consolidated medium to coarse-grained sand, silt, and gravel. Middle to late Holocene alluvial fan deposits are typically too young (i.e., less than 5,000 years old) to preserve paleontological resources and are also determined to have a low paleontological sensitivity according to SVP (2010) standards. However, middle to late Holocene alluvial and fluvial deposits may grade downward into more fine-grained deposits of early Holocene to late Pleistocene age (e.g., Qo) that could preserve fossil remains at shallow or unknown depths. Quaternary young alluvial fan and fluvial deposits (Q, Qal) are assigned a low paleontological sensitivity at the surface, and a high paleontological sensitivity at depths below 5 feet.

Quaternary Old Alluvium

Late to middle Pleistocene alluvium (Qo), which is mapped extensively throughout the Agua Caliente, Santa Rosa, and Sonoma Potential Sites consists of well consolidated, crudely stratified, light yellowish-brown, texturally massive to faintly laminated, poorly sorted, fine- to coarse-grained sand with sparsely distributed pebble beds (Blake et al. 2002; Wagner and Bortugno 1982). Quaternary old (early Holocene to Pleistocene) fine-grained alluvial deposits have a well-documented record of abundant and diverse vertebrate fauna recorded throughout California (Paleobiology Database 2020). Jefferson (2010) has reported numerous vertebrate fossil taxa from Sonoma County and neighboring counties including horse, tapir, bison, camelid, deer, mastodon, mammoth, ground sloth, canine, rabbit, and rodent. Late to middle Pleistocene alluvium (Qo) is assigned a high paleontological sensitivity.

Quaternary Old Alluvial and Marine Terrace Deposits

Middle to early Pleistocene marine terrace deposits (Qt), mapped within a Guerneville Potential Site (GUE-1), consist of siliceous, fine-grained marine sediments and terrestrial alluvium that accumulated on a series of wave-cut platforms formed during late Pleistocene. Pleistocene terrace deposits have a record of vertebrate fossil preservation in California and have produced scientifically significant specimens from multiple localities. In coastal California, Pleistocene marine terrace deposits have yielded vertebrate fossil specimens of camel, horse, ground sloth, whale, and dolphin, shark, and fish (Jefferson 2010; Woodring et al. 1946). Middle to early Pleistocene marine terrace deposits (Qt) are assigned a high paleontological sensitivity.

Pleistocene Huichica and Glen Ellen Formations

Pleistocene Huichica and Glen Ellen Formations (QT), mapped within the Glen Ellen Potential Sites, consist of brown- to buff weathering, interbedded siltstone, fine- to coarse-grained sandstone, pebbly and cobbly sandstone, conglomerate, and tuff (Blake et al. 2002; Wagner and Bortugno 1982). A review of the museum records maintained in the University of California Museum of Paleontology (UCMP) online collections database identified several fossil localities from Pleistocene Huichica and Glen Ellen formations within Sonoma County, which produced several horse teeth, freshwater molluscs, plant remains, and diatoms (UCMP locality V90056) (UCMP 2020). Pleistocene Huichica and Glen Ellen Formations (QT) are assigned a high paleontological sensitivity.

Pleistocene to Pliocene Petaluma Formation

The mostly non-marine Pleistocene to Pliocene Petaluma Formation (Pp), mapped extensively within the Penngrove Potential Sites, has a maximum thickness of about 4,000 feet and consists primarily of clay, sandstone, and minor conglomerate (Blake et al. 2002; Wagner and Bortugno 1982). According to the museum records maintained in the UCMP online collections database, at least nine vertebrate localities were identified from the Petaluma Formation (UCMP 2020), which yielded fossil specimens of rabbit (Leporidae), horse (*Equus, Neohipparion gidleyi*), turtle (Testudines), camel (Camelidae), rhinoceros (Rhinocerotidae) within Sonoma County. Pleistocene to Pliocene Petaluma Formation (Pp) is assigned a high paleontological sensitivity.

Late Pliocene to late Miocene Wilson Grove Formation

Late Pliocene to late Miocene Wilson Grove Formation (Twg, Pwg), mapped within the Graton, Forestville, and Petaluma Potential Sites, consists of fine grained, well sorted, massive to poorly bedded, light gray to light yellow-brown marine sandstone with thin lenses of pebble conglomerate. According to the museum records maintained in the UCMP online collections database, UCMP localities V81135 and V92001 produced fossil specimens of cartilaginous fish (*Cetorhinus maximus, Isurus oxyrhynchus, Hexanchus griseus*) and bony fish (*Sardinops, Sarda, Merluccius*) from the Wilson Grove Formation within Sonoma County (UCMP 2020). Late Pliocene to late Miocene Wilson Grove Formation (Twg, Pwg) is assigned a high paleontological sensitivity.

Pliocene to Miocene Sonoma Volcanics

Pliocene to Miocene Sonoma Volcanics (Psv, Tsb), mapped within a Petaluma Potential Site (PET-4), consists of basalt, andesite, and rhyolite lavas interbedded with debris avalanche deposits. Certain facies, such as the basaltic and andesitic lava flows are extremely unlikely to yield fossils, whereas others such as tuffs, mudflows, and lacustrine facies have yielded significant fossils within Sonoma County. Given the lithology, Pliocene to Miocene Sonoma Volcanics (Psv, Tsb) underlying PET-4 have no paleontological sensitivity since the physical parameters of their formation are not conducive to fossil preservation. Pliocene to Miocene Sonoma Volcanics (Psv, Tsb) have no paleontological sensitivity.

Late Eocene to Late Cretaceous Franciscan Complex

Late Eocene to Late Cretaceous metasedimentary rocks of the Franciscan Complex (Tsb, TKfs, KJfs, KJfm), mapped within a Guerneville Potential Site (GUE-3), consist of submetamorphosed eugeosynclinal marine sedimentary and mafic igneous rocks, including dark gray to black metabasalt greenstone. Late Eocene to Late Cretaceous metasedimentary rocks from the Franciscan Complex formed from the cooling of molten rock that was subsequently metamorphosed. The high-heat and high-pressure conditions in which these rocks formed are not suitable for life or fossilization. Consequently, metasedimentary rocks from the Franciscan Complex (Tsb, TKfs, KJfs, KJfm) have no paleontological sensitivity (SVP 2020).

Early Cretaceous to Late Jurassic Great Valley Complex

Early Cretaceous to Late Jurassic rocks from the Great Valley Complex (KJgvc), mapped within a Geyserville Potential Site (GEY-4), consist of conglomerate, sandstone, siltstone, and shale. Early Cretaceous to Late Jurassic rocks from the Great Valley Complex have yielded several paleontological resources throughout California (Blake et al. 2000; 2002). A search of the paleontological locality records maintained in the online Paleobiology Database indicates that Early Cretaceous to Late Jurassic rocks

from the Great Valley Complex have rendered various significant fossil specimens of extinct cephalopod (Ammonoidea), sea urchin (Echinoidea), and cartilaginous fish (Elasmobranchii) within neighboring counties (Paleobiology Database 2020). Early Cretaceous to Late Jurassic rocks from the Great Valley Complex (KJgvc) are assigned a high paleontological sensitivity.

Depth to Paleontologically Sensitive Units

Quaternary young (middle to late Holocene) alluvial fan and fluvial deposits (Q, Qal) have a low paleontological sensitivity at the surface as defined by SVP (2010) standards; however, middle to late Holocene deposits may grade downward into more fine-grained, fossiliferous deposits of early Holocene to late Pleistocene age (i.e., Qo, Qt), late Pliocene to late Miocene (i.e., Twg, Pwg), or Early Cretaceous to Late Jurassic (KJgvc) at shallow or unknown depths. Accurately assessing the boundaries between younger and older units within the Potential Sites is generally not possible without site-specific stratigraphic[1] data, some form of radiometric dating[2] or fossil analysis, so conservative estimates of the depth at which paleontologically sensitive units may occur reduces potential for impacts to paleontological resources. The depths at which these units become old enough to yield fossils is highly variable, but generally does not occur at depths of less than 5 feet. Given the proximity of geologic units with high paleontological sensitivity (i.e., Qo, Qt, Twg, and KJgvc) mapped near the Geyserville, Guerneville, Larkfield, Graton, and Santa Rosa Potential Sites, early Holocene to late Pleistocene age (i.e., Qo, Qt), late Pliocene to late Miocene (i.e., Twg), and/or Early Cretaceous to Late Jurassic (KJgvc) deposits are likely present at relatively shallow (i.e., between 5 to 10 feet) depth below younger alluvial sediments (Q, Qal). As noted above, early Holocene to late Pleistocene age, late Pliocene to late Miocene, and Early Cretaceous to Late Jurassic (KJgvc) sedimentary deposits have a well-documented record of abundant and diverse vertebrate fauna throughout California (Jefferson 2010; Paleobiology Database 2020; UCMP 2020). Therefore, areas mapped as Quaternary young (middle to late Holocene) alluvial fan and fluvial deposits (Q, Qal) are assigned a high paleontological sensitivity at depths greater than 5 feet (SVP 2020).

[1] Rock layers in the geologic units below the Potential Sites.
[2] Technique to determine the age of the geologic units below the Potential Sites.