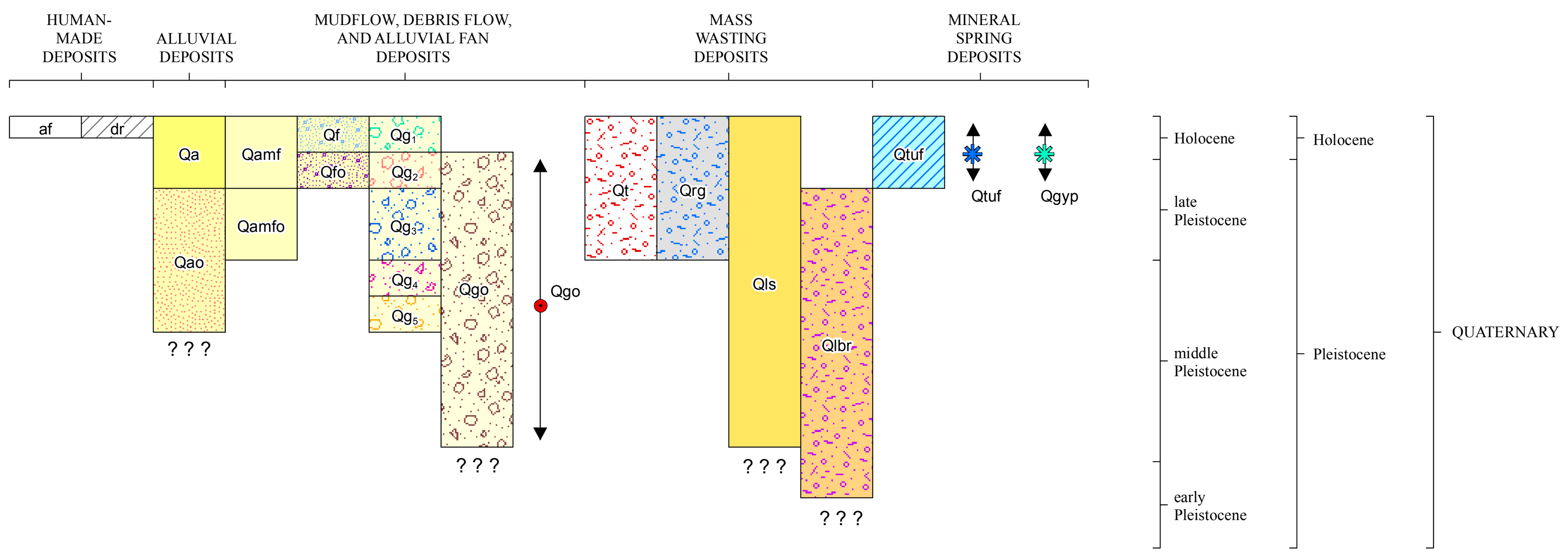
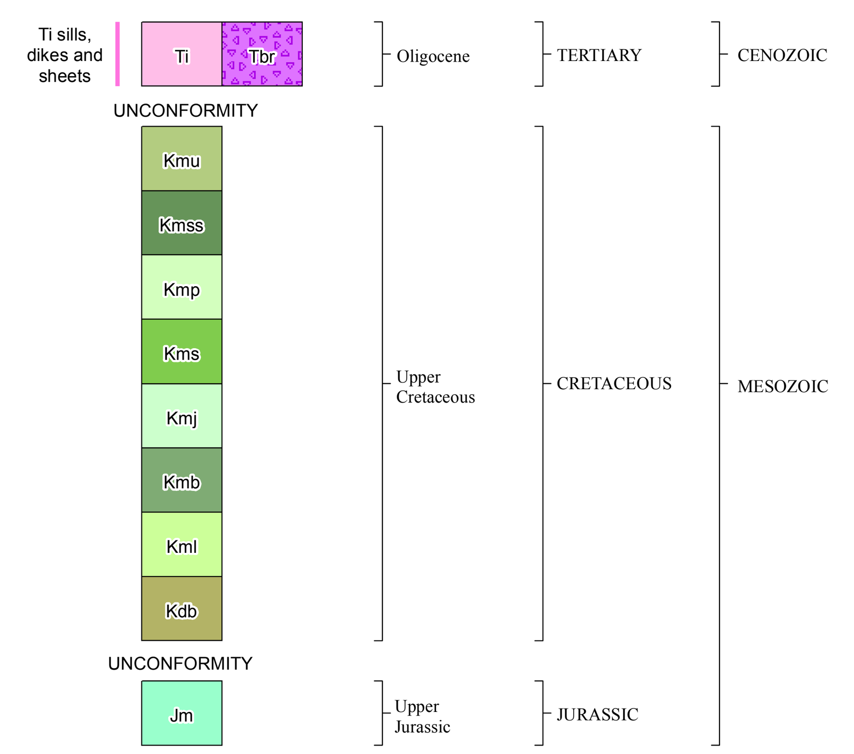
CORRELATION OF MAP UNITS

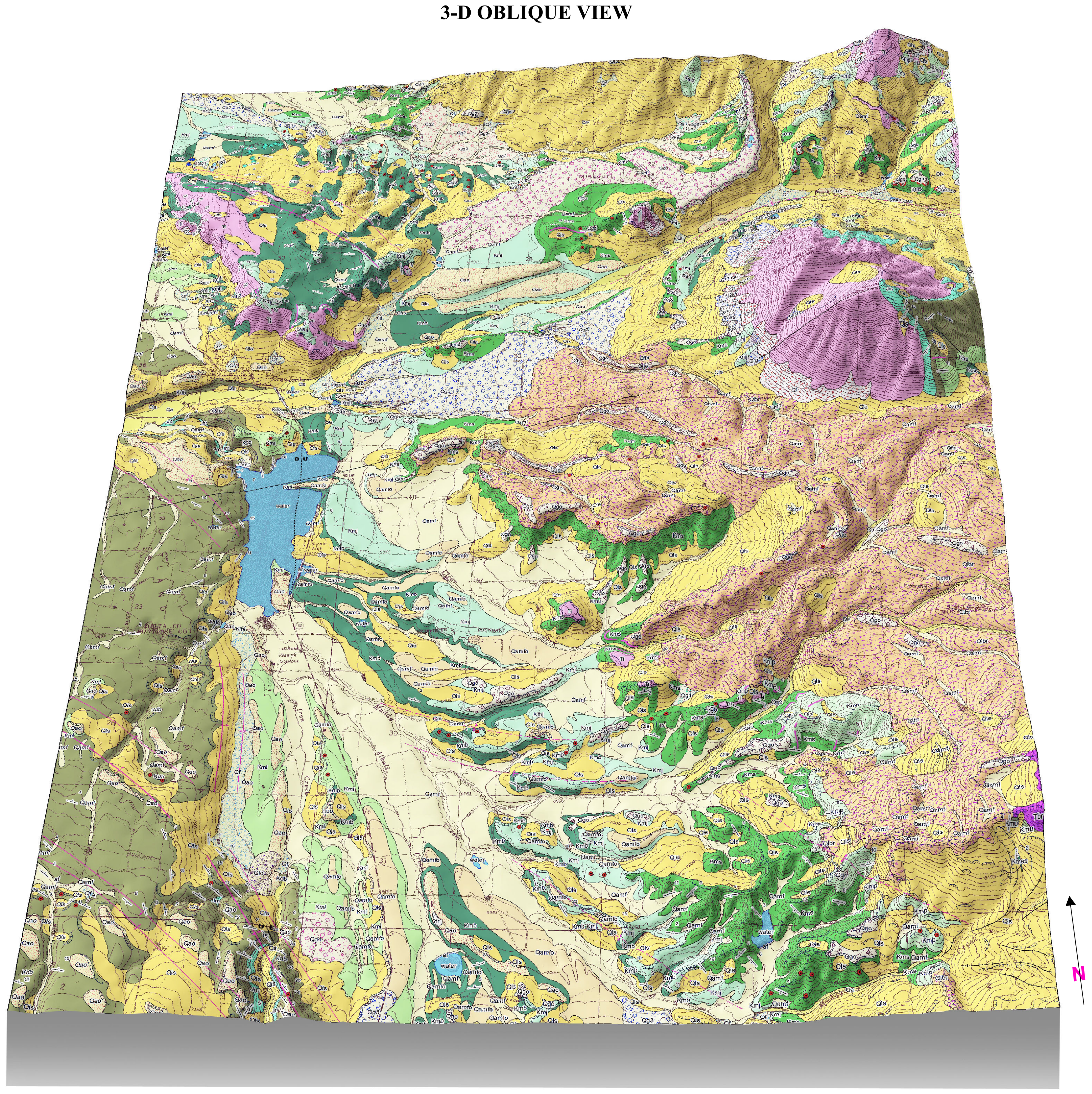
SURFICIAL DEPOSITS



BEDROCK UNITS

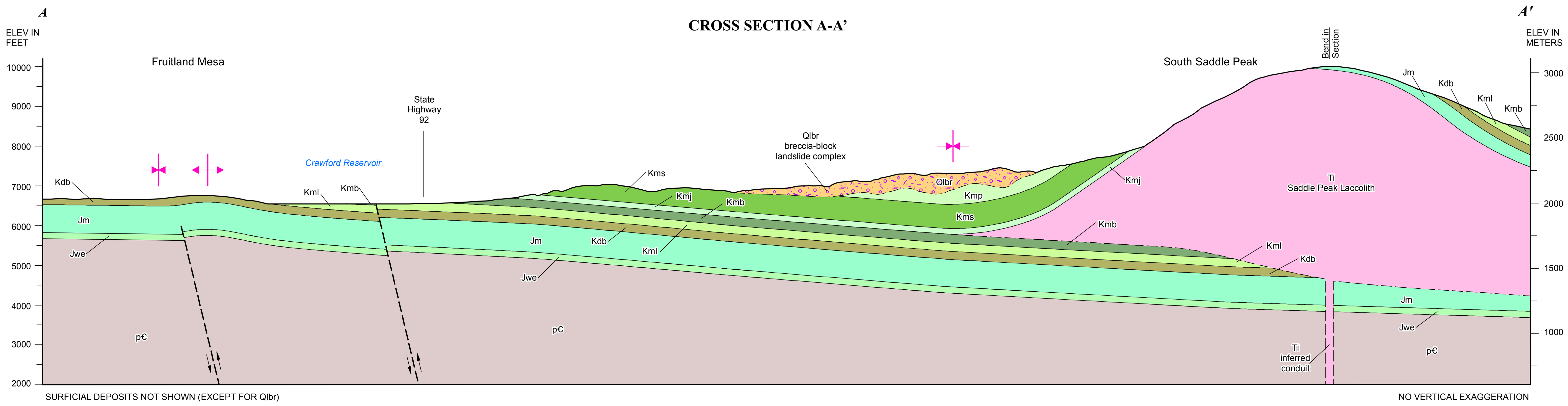


3-D OBLIQUE VIEW



Vertical Scale Exaggeration 1.5:1

CROSS SECTION A-A'



GEOLOGIC MAP OF THE CRAWFORD QUADRANGLE, DELTA AND MONTROSE COUNTIES, COLORADO CORRELATION OF MAP UNITS, 3-D MAP, AND CROSS SECTION

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STRUCTURAL GEOLOGY

Based on our field measurements, the regional dip of sedimentary strata in the Crawford quadrangle is at gentle angles, typically less than 10°, toward the northeast. This marks the regional tilting of the Gunnison uplift, a feature that was formed during the Laramide orogeny during Late Cretaceous to Early Tertiary time (Hansen, 1965; Dickinson and others, 1988). The regional dip is interrupted in places by monoclinal folding, or by intrusive igneous bodies. The monoclinal folding is best seen along Fruitland Mesa in the southwestern part of the map area, where the Dakota Sandstone is broken by local anticline-syncline pairs or limbs of steeper strata (with dips of 20° to 34°), having NW-SE and N-S axial orientations. More gentle folding of the same type, having NW-SE axial orientations, is indicated in the Mancos Shale in the south-central part of the quadrangle, although the outcrop exposures are poor.

Intrusive igneous laccoliths may be surrounded and draped by Mesozoic strata that have been locally uplifted and displaced during the emplacement of the intrusion (such as North and South Saddle Peak, Little Sand Mountain along the eastern map boundary north of Smith Fork, and possibly Needle Rock). The basal draping sedimentary strata are variable in age, ranging from rocks of the uppermost Morrison Formation to the middle Mancos Shale. In most places, the draping strata have been metamorphosed to hornfels, metasiltstone, and quartzite. For other laccoliths (such as Second Creek Ridge and Landsend Peak, along the northern map boundary), it appears that the sedimentary bedrock is not uplifted, and that strata of the upper parts of the Mancos Shale may dip beneath the base of intrusive body. The Youngs Peak massif takes on its peculiar shape by having a laccolithic body at its southern end, forming its main peak, and intrusive sheets and dikes of the same material along its southwestern and southeastern margins. The bounding Mancos Shale sedimentary strata (mostly hornfels of the Blue Hill Member) are folded in monoclinal fashion along the edges of the massif, presumably along the edges of the intrusive sheets. Needle Rock has previously been interpreted to be the remnant plug or neck of a magma conduit that fed a former laccolithic body at a higher elevation, now eroded away (Gaskill, 1977). Our structural readings and observations, however, indicate that Mancos Shale strata are dipping somewhat radially away from the feature. The igneous rock mass at the base of the sheer cliffs assumes a cone-like shape that extends into the ground. Furthermore, our mapping observations from the region indicate that most of the laccolithic igneous bodies have experienced only marginal erosion. We propose an alternative interpretation: that Needle Rock may be the crown of a buried laccolith of unknown size, draped by uplifted shale strata and capped with possibly two generations of stubby, vertical crown dikes. Our interpretation is problematic in that the Mancos Shale surrounding Needle Rock does not show any appreciable metamorphism to hornfels. More work is needed to discern whether this notable feature is the remnant of a sub-laccolith feeder system, or whether it is the top of a buried laccolith.

We recognized few faults during our field work. In part, it appears that most of the sedimentary strata is folded either as monoclinal folds, presumably overlying deeper basement faults, or as synclinal folds that may form “moats” around the margins of the Saddle Peak laccolith. The only well-exposed faults we encountered are along the western shore of Crawford Reservoir, near the dam. (Because of their very localized distribution, on the water's edge at the base of a landslide, the faults are not shown on the map.) There, four closely spaced faults have an E-W orientation and form grabens and horsts with mostly down-to-north, normal movements with apparent displacements of 5-15 feet. A larger, low-angle thrust fault may be present in that area, but was too poorly exposed to verify. We map an inferred fault with N-S orientation and down-to-east displacement in the vicinity of Crawford Reservoir, based on the narrowing of Mancos Shale outcrops and inferred faulting out of the lower Mancos and Blue Hill Member sections. Finally, we hiked through and examined the saddle between North and South Saddle Peaks, to look for an explanation for the presence of this peculiar geomorphic feature. We found no evidence of faulting between the peaks, nor any other feature that would explain the saddle.

MINERAL RESOURCES

Four oil-and-gas test wells have been drilled: one near Missouri Flats, two in the Smith Fork valley to the southwest and northeast of Crawford, and one along D Road to the southeast of Crawford. All were dry holes except for the latter well, which produced a small volume of oil from the Dakota Sandstone and was later plugged and abandoned. This well constitutes the Crawford oil field (Wray and others, 2005). Sand and gravel have been mined from only a few locations (Guilinger and Keller, 2002; Keller and others, 2002). The sources include an ancient deposit of Muddy Creek (unit **Qao**) southeast of Maher, and a fan deposit (unit **Qf**) at the base of Youngs Peak in Crawford. A small, inactive quarry is located at the southeastern tip of the Youngs Peak massif, in a cliff of monzonite porphyry (unit **Ti**); we are not aware of how the quarried stone was used.

GROUNDWATER RESOURCES

There are 59 groundwater wells in the Crawford quadrangle, all of which are permitted for domestic or household use (Colorado Division of Water Resources, 2011). The wells are scattered across the central and western parts of the quadrangle, occupying a variety of geologic settings, and range from 20 to 917 feet deep. Target aquifers may include the Dakota Sandstone and Burro Canyon Formation (unit **Kdb**), the Morrison Formation (unit **Jm**), fractured Mancos Shale hornfels adjacent to igneous laccoliths, landslides (units **Qls** and **Qlbr**) and modern and ancient alluvial and gravel deposits.(units **Qa, Qao**, and **Qg**-series).

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