

GEOLOGIC MAP OF THE CENTRAL BUTTE RANGE, WHITE PINE COUNTY, NEVADA

Bruce R. Otto 2008

Qal Alluvial deposits undifferentiated Includes pediment talus aprons, gravel accumulations in dry washes and vegetated playa lake deposits.

VOLCANIC ROCKS

Tb **Mafic lavas (Tertiary)** Occurs only in the northern half of the map area in a relict west-northwest-trending graben. Well-exposed, cliff-forming basaltic lavas. Groundmass is microcrystalline to glassy with subhedral plagioclase laths up to 1 cm long and subordinate subhedral to euhedral pyroxene comprise the phenocryst population. Brown to reddish brown on weathered surfaces, dark charcoal gray to black on fresh surfaces. Lies conformably on Paleozoic rocks and disconformably on gravels of unit Tg. Represents the youngest unit in the mapped area; over 500 m thickness remains preserved.

Y **Silicic vent (Tertiary)** Occurs only in the SW¼, Section 24, T22N, R56E. Recessive, non-outcropping unit consisting of angular fragments of altered Paleozoic rock in a groundmass of rock flour, shattered subhedral quartz crystals and subordinate broken biotite euhedra. Forms anomalously white clay-rich soil. Vent is entirely crosscutting, and apparently did not develop an effusive carapace.

SEDIMENTARY ROCKS

Tg **Unlithified Tertiary sediments** Restricted to a small part of the mapped area, includes recessive, unconsolidated fluvial and colluvial accumulations of gravel derived dominantly from a local Paleozoic source terrain. The unit is Eocene or older because it occurs below 39-Ma mafic lava flows (date from C. Nutt, personal commun.). Where fluvial, sediments include locally derived lithologies that range from sand fraction to moderately well-sorted 0.5-m-diameter clasts. Most of the clasts are in the size range of 20 to 30 cm. The colluvial gravels are derived from the same source terrain; they are unsorted, non-rounded, and form plateaus of fanlomerate that can be distinguished from presently forming Quaternary fanlomerate by their deeply dissected geomorphic signature and their stratigraphic position below the lavas.

Arcturus Formation (Permian)

Par **Reef facies** Occurs as cliff-forming outcrops in the cores of synclines in the southern part of the map area and at high elevations in the northern part. Bedding is generally massive with internal 1- to 5-cm-thick lenticular and undulatory depositional units. The fossil component is generally greater than 30%, and includes abundant and pervasive brachiopods, crinoids, gastropods, and sponges(?) that act as a framework for micritic mud. The sponge-like biota are 2-3 cm in diameter, approximately 10-20 cm long, and locally contain hollow centers. They commonly branch into two tubes in an upward direction. They occur both normal to bedding in a growth position, and parallel to bedding. Local accumulations of colony corals and bryozoans also occur but are not common. Crinoid stem fragments are locally abundant and range up to 2 cm in diameter. None of the fossils show preferential orientations from current reworking. Cream to buff or tan on weathered surfaces, cream, tan, or light gray on fresh surfaces. The base of the unit lies conformably on the Platform facies (Pap). The unit is the highest Paleozoic strata exposed in the area so its total thickness is unknown because of erosion; its minimum thickness is 1200 m.

Pat **Fore-reef facies** Distributed extensively throughout the northern half of the map area, does not occur in the South where unit Par lies directly above unit Pap. Recessive unit of laminated to thin-bedded calcarenite and sandy limestone. Consists of 1- to 3-cm-thick beds with laminated mud parting surfaces. Beds are generally planar but locally include unidirectional asymmetric ripple marks. Stage-shelled nautiloids are strongly current oriented in southerly exposures and randomly oriented to the north. The clastic component comprises well-sorted terrigenous, carbonate-cemented quartz sand with a grain size of 80 to 200 micrometers. Basal part of unit contains a distinctive biological population that I used to identify the unit regionally. It contains well preserved pseudoplanispiral gastropods (*Amphiscapha?*), orthostrophic type conispiral gastropods (*Murchisonia?*), straight-shelled nautiloids (*Melchiorites?*), ammonoids (*Goniatites?*), and brachiopods. In southerly exposures they occur as localized thin bioclastic debris flows scattered intermittently through a thin-bedded to laminated limestone sequence; to the north they occur at the same lithostratigraphic level but are more evenly scattered in laminated and thin-bedded lime mud.

Medium to light brown or yellowish brown on weathered surfaces, medium brown to light gray on fresh surfaces. Unit has a minimum thickness of 500 m. Its base is gradational, and is best defined by the last occurrence of massive micrite beds of unit Pap. The top is everywhere tectonically altered. Pap limestone occurs as thrust sheets that terminate the top of unit Pat.

Pap **Upper transitional facies** This unit is present only in the northern part of the map area, where present it is not everywhere mapped as a distinct facies due to a lack of adequate exposure. Where not separately mapped it is included as the basal part of unit Pat. Moderately recessive unit composed of lithologies intermediate between the fore-reef facies (Pat) and the platform facies (Pap), including carbonate-cemented quartz sandstone, bioclastic limestone, and massive micrite. Massive micrite stands out in strong relief; the calcarenite is recessive. Unit progresses from medium to thick beds of massive micrite separated by thin-bedded sandy partings at the base systematically upward to entirely thin-bedded calcarenite. The unit typically does not contain fossils except local accumulations of crinoid stem fragments. Color is variable; the massive micrite beds are light to medium gray on fresh and weathered surfaces; the calcarenite is generally pastel brown to light tan on weathered surfaces and medium to light gray-brown on fresh surfaces. The lower contact is sharp and is based on the first occurrence of calcarenite beds between massive micrite beds; the upper contact is gradational over 30 to 50 m and is based on the last occurrence of massive micrite beds. The unit ranges from 0- to 100-m-thick.

Pap **Platform facies** Occurs throughout the map area but is best exposed in the middle to northern part of the area. Cliff-forming unit of medium- to thick-bedded or massive micrite. Beds are generally massive and show no bed forms. Locally includes concentrations of 200- to 300-micrometer quartz sand grains floating in a carbonate matrix, but is otherwise strictly micrite or a recrystallized equivalent. Local accumulations of thin- to medium-bedded carbonate-matrix, graded conglomeratic turbidites occur in the upper half of the unit. Clasts in the conglomerates are composed mostly of quartzite and chert; they are well rounded and range up to 2 cm in diameter. Much of the original rock texture is destroyed by partial to total dolomitization. The dolomitic parts of the unit form highly resistant, white to very light gray outcrops. The distribution of dolomite was not mapped due to masking by later epigenetic silicification. Contains a sparse and highly fragmented fossil population locally, including fusulinids, brachiopods and crinoid stems. The fusulinids are generally restricted to near the top of the unit. The base of the unit is sharp, defined by the last occurrence of Rib Hill-type sands. The upper contact is defined by the first occurrence of thin-bedded calcarenite of Pat, or Pat. The unit is present throughout the mapped area and ranges from 200 m to over 500 m thick. It lies conformably on the Rib Hill Sandstone or the Pat, transitional facies; locally it interfingers with the Pat, transitional unit. Where Pr and Pat, are not present, Pap lies disconformably on the Ely limestone and is separated by a 20- to 30-m-thick intraformational breccia.

Pat **Lower transitional facies** Occurs in abundance in northern third of McBrides Sheep Well Quadrangle and to north pinches out to south. Recessive unit with similar lithologies to unit Pat; thin- to medium-bedded calcarenite, carbonate-cemented fine-grained quartz sandstone, and thin-bedded to laminated limestone. Contains locally extensive accumulations of crinoidal limestone. Where present, the crinoids form over 80% of the rock; individual stem fragments range in diameter to over 3 cm, which makes this unit distinct from other crinoidal limestones in the section. Generally light-brown to yellow on weathered surfaces and medium-brown to medium-gray on fresh surfaces. The crinoidal limestone is typically light gray on both weathered and fresh surfaces. Thickness ranges from 0 to over 600 m. Its base is gradational (commonly indistinguishable) with the underlying Rib Hill Sandstone; the top contact is sharp with the overlying Pap unit. Much of the thicker parts of unit Pat, show lateral facies transitions into the thick-bedded carbonates of Pap, which is why I include it in the Arcturus Formation.

Pr **Rib Hill Sandstone (Permian, Leonardian?)** Occurs intermittently throughout map area, but generally thickens and is more abundant to north. Recessive, talus-forming unit of thin- to medium-bedded calcite-cemented sandstone. Composed of quartz sand grains with a uniform fine to medium grain size. Unit consists of amalgamated beds that are generally massive but locally show internal planar laminations and asymmetric current ripples. Fossils are generally absent, though some locations in the northern part of the McBrides Sheep Well Quadrangle have a basal crinoidal limestone, which presents difficulty in separating this unit from Pat. Color varies between hematitic red, yellow ochre, and pastel brown on weathered surfaces; it is medium brown to brown gray on fresh surfaces. Lies disconformably above the Ely Limestone. The basal contact is sharp; the top contact is sharp where overlain by unit Pap, but is gradational where overlain by unit Pat. I use the first occurrence of bioclastic limestone beds to define the overlying base of the unit Pat. Thicknesses vary from non-deposition to 4100 m. The large thicknesses described by Hesse and Blake (1976) are derived from their inclusion of my Pat, unit into their Rib Hill.

Ely Limestone (Pennsylvanian)

Pfp **Platform facies (Desmoinesian?)** Occurs throughout the map area. Bold, outcrop-forming unit of medium to thick, planar-bedded micritic limestone that forms a distinctive ledge-and-slope topography. Micrite beds are generally thick to amalgamated and do not show sedimentary textures except for local planar laminations. Contains abundant and distinctive concentrations of chert. The chert is bedding parallel, generally displays irregular and diffuse upper and lower margins, averages 2-5 cm thick, and represents up to 30% of most outcrops. I used the presence of significant chert to distinguish this unit from the platform carbonates of unit Pap. Contains a sparse fossil population of highly fragmented crinoid stems, brachiopods, and locally corals and fusulinids. Medium to light gray on weathered surfaces, medium gray to locally dark gray on fresh surfaces. The lower contact with the Diamond Peak Formation is gradational over less than 10 m; the upper contact is an erosional surface, above which is either the Rib Hill Sandstone or the platform facies of the Arcturus Formation (Pap). An intraformational breccia occurs within the Ely where the Rib Hill Sandstone is not present. Thickness of the unit varies greatly from 300 m to more than 800 m.

Pp **Reef facies** Occurrence is restricted to the northern part of the McBrides Sheep Well Quadrangle. Bold, cliff-forming limestone unit that is lithologically similar in most respects with the platform facies. Differences include a greater diversity and abundance of fossils, and a significantly greater bed thickness. The fossils, some of which are in their growth position, include an abundance of brachiopods, bryozoans, corals, sponges(?), and crinoids. The lower contact with the Diamond Peak Formation is gradational over less than 10 m; the upper contact is sharp with the Pat, transitional facies. Thickness of the unit is at least 800 m.

Mdp **Diamond Peak Formation (Mississippian)** Occurs in the foothills along the west flank of the Butte Range. Represents lowest exposed unit in map area. Composed of two surfaces that were not mapped separately. Sandstone facies is generally more recessive than the conglomerate facies; both stand out locally with good outcrop. The base of the unit is not exposed; the top is gradational over 10 m or less to the Ely Limestone. The gradation is marked by a systematic increase in strongly cross-bedded and resedimented clastic carbonate beds within silicified detrital beds, thence to primary carbonate beds of the Ely. The conglomerates consist of well rounded pebbles to cobble size quartzite and chert fragments in a fine-sand to mud matrix. The conglomerate occurs as lenses within fine grained material and as amalgamated lenses. Most depositional units show either reverse or bidirectional grading. The sandstones consist of medium- to coarse-grained quartz sand with local pebbles of quartzite, chert, and locally, fossilized wood fragments. Asymmetric current ripples are the dominant bedform where present, but most of the unit is planar laminated. Several measurements of the current ripples indicate a transport direction of S20°-30°W (Shallow well area, Sunshine Well NW Quadrangle).

ALTERATION

Stratobound dolomitization, silicification, recrystallization and bleaching Occurs within the platform carbonate of unit Pap. Texture destructive alteration has destroyed features and has masked all bed forms. Restricted to southern half of mapped area. Silicification and bleaching overprints the dolomite and is spatially associated with thrust faults. The most intensely developed portions generally occur in the brecciated hanging walls of the larger displacement faults and is strongest near the base of individual thrust sheets. The silicification is chaotic and bedding controlled, though crosscutting replacement veins are generally present. Where bedding is the primary control, the chaoticity follows bedding precisely; intervening non-silicified beds are composed of coarsely crystalline dolomite. Where discordant to bedding the quartz always cuts the dolomite. Unaltered and unconsolidated gravels of unit Tg occur as a channel-filling sequence that was cut into the altered carbonate strata, demonstrating that alteration is older than 39 Ma.

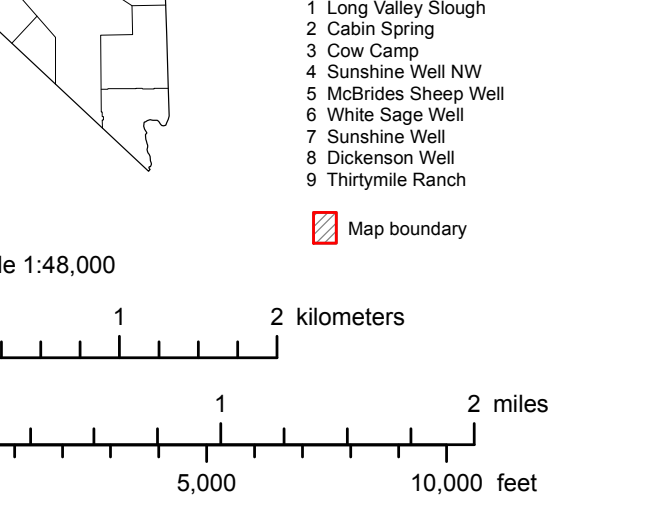
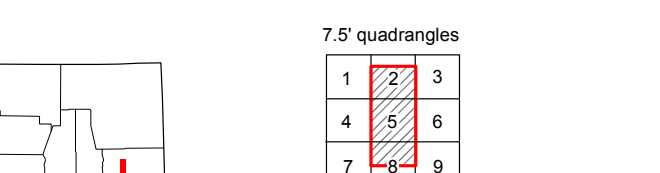
Intensely developed breccia Generally associated with thrust faults, and hosted by strongly altered platform carbonate of unit Pap.

See accompanying text for references and descriptions of structure and stratigraphy.

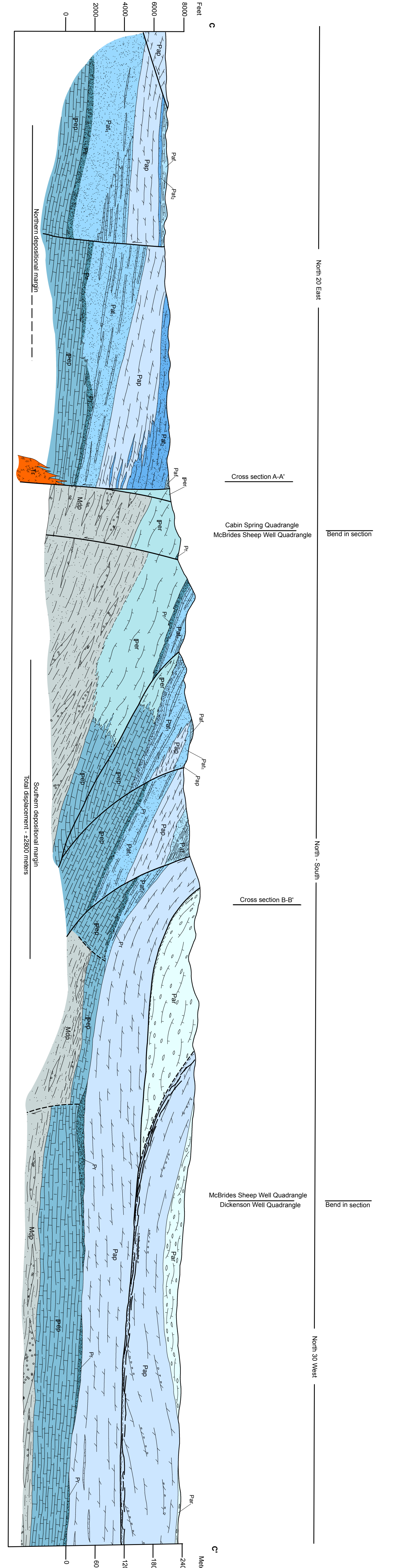
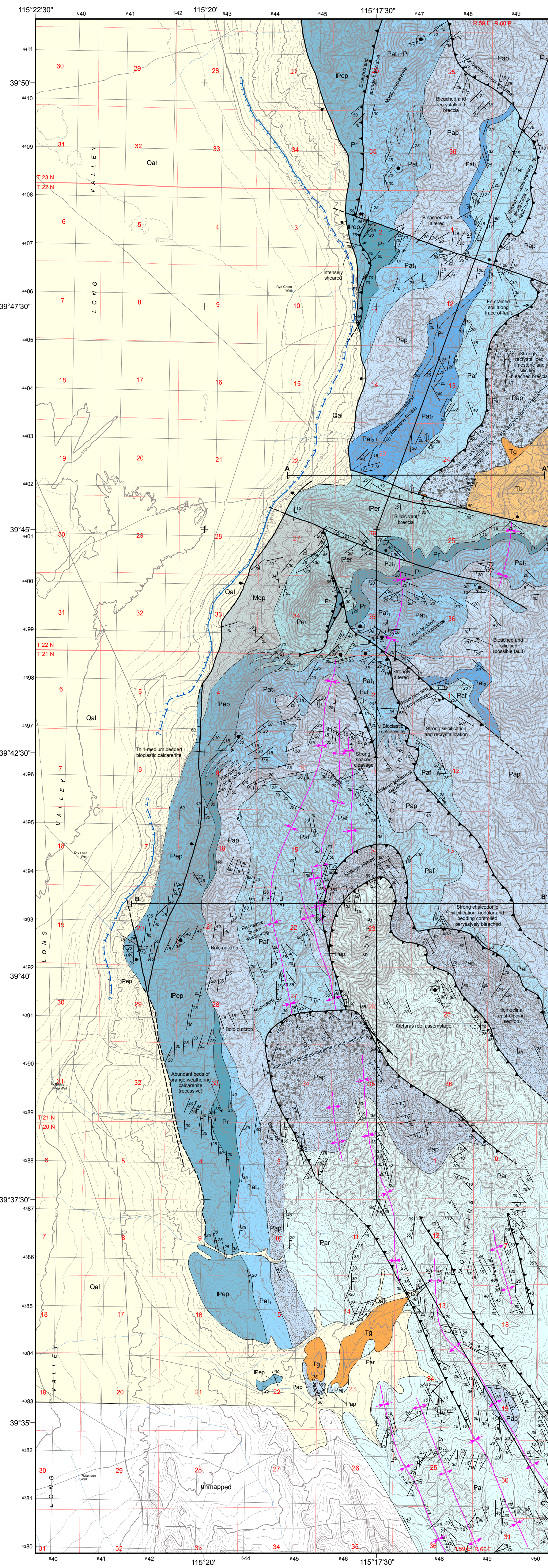
Symbology (per FGDC-STD-013-2006)

- Contact** Solid where certain and location accurate, short-dashed where inferred.
- Fault** Solid where certain and location accurate, short-dashed where inferred. Ball on downthrown side.
- Thrust fault** Solid where certain and location accurate. Sawtooth on upper plate.
- Shoreline cliff** Solid where certain and location accurate, dashed where inferred; queried if identity or existence uncertain. Hashmarks point down cliff.
- Anticline** Solid where certain and location accurate.
- Syncline** Solid where certain and location accurate.

- Strike and dip of beds**
 - 45° Inclined
 - 90° Overtuned
- Fracture cleavage**
 - 40° Inclined
- Brachiopod**
- Fusulinid**
- Crinoid**
- Gastropod**



Base map: Adapted from U.S. Geological Survey Cabin Spring, Dickenson Well, McBrides Sheep Well 7.5' quadrangles
Projection: Universal Transverse Mercator, Zone 11, North American Datum 1927 (m)



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