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**Item S1. Reconstruction of thickness of overlying sediment packages**

*Maximum preserved thicknesses of strata that could conceivably cap the D1 Sequence:*

Although we do not think that all of the units in Figure 2 and Figure 4 actually capped the D1 Sequence at Corral Bluffs, it is not possible to falsify the hypothesis that they did not do so, even if such a scenario seems unlikely given the lateral heterogeneity in distribution and thickness represented by these units in the Front Range; especially variable are the younger alluvial and paleovalley deposits in the succession, which are only known from northern Colorado. However, to be exhaustive and conservative in our assessment, we treat each unit individually and conservatively in our burial depth calculations. The maximum conceivable thickness of strata that sans the issues of unknown extent of erosion, that could have been deposited above the K-Pg at Corral Bluffs, is 1,256 m of rock, and the minimum amount, taking into account what we expect about the spatial distribution of thicker Mio-Pliocene units in the region, and in light of well logs, core, and outcrops to the west, north, and east of Corral Bluffs (synthesized in Dechesne et al., 2011) would have been as thin as 590 m. Units are listed in stratigraphic order, with the maximum measured thickness of the unit in parentheses.

Ogallala Fm (183 m): Based on erosional remnants in northeastern Colorado, the thickness of this unit varies from 58-183 m (Galbreath, 1953; Scott, 1978).

Pawnee Creek Fm (47 m): This incised paleovalley sequence varies considerably in its thickness and lateral extent; it is best known from the Pawnee Buttes area of northern Colorado (Galbreath, 1953; Tedford, 2004).

Martins Canyon Fm (55 m): This paleovalley fill succession has varied thicknesses, from a few m to 55 m (Tedford, 1999; 2004) and is only known from northern Colorado in the Pawnee Buttes area.

Arikaree Fm (46 m): Thickness is highly variable, with channels and paleotopography and preservation determining thickness; in northeastern Colorado it ranges from 6-46 m (Scott, 1978).

White River Group (152 m): Varies considerably in thickness; in northeastern Colorado ranges from 61-152 m (Scott, 1978).

Castle Rock Conglomerate (80 m): This unit is up to 80 m thick, but could be as little as 20-30 m thick near Corral Bluffs, depending on where the margins of the Cherokee Mountain paleovalley were (Koch et al., 2018).

Wall Mountain Tuff (aka Castle Rock Rhyolite; 15 m): Although present to the north and west of the study area, where it is approximately 2-15 m thick, this unit is not known to have capped the Corral Bluffs region (Epis and Chapin, 1974; Thorson, 2011).

Larkspur Conglomerate (12 m): This 7-12 m thick unit is not always present and its thickness varies depending on whether there is a paleovalley present to accommodate its deposition. In the southern Denver Basin, it may be overlain by either the Wall Mountain Tuff or the Castle Rock Conglomerate (Morse, 1985; Thorsen, 2011).

D2 Sequence (244 m): The thickness of this unit is quite variable, and it was likely much thicker prior to downcutting and erosion during the formation of the Rocky Mountain erosion surface. At Corral Bluffs, the D2 Sequence has been removed, so its maximum thickness is unknown. The regional 600’ and 800’ isopachs of the D2 project into Corral Bluffs (Raynolds, 2002) and can be used to estimate the minimum and maximum expected thickness of the D2 in Corral Bluffs region. These values, of 183 to 244 m, are in agreement with regional variations in thickness of the D2 and the underlying D1 sequence. For example, the thickest sections of the D2 are near Bald Mountain and Austin Bluffs (Scott and Wobus, 1973; Soister and Tschudy, 1978), where the unit it is 346+ m thick (1,135’ in PowerCo Uranium Company well; Dechesne et al., 2011); the next thickest exposures are in Cherry Valley, where the unit is 260+ m thick (Thorson, 2004).

Denver Basin Paleosol (8 m): The thickness of this thin, easily-weathered unit is quite variable (Farnham and Kraus, 2002) and locally it may be absent. It may represent a composite unit of stacked paleosols (Nichols and Fleming, 2002).

D1 Sequence (625 m): The stratigraphically lowest articulated turtle in the D1 is 36.17 m above the K/Pg at Corral Bluffs, and the highest one is 109.57 m above the K/Pg at the same locality. At Corral Bluffs, the top of the D1 sequence has been removed by erosion, and the paleosol-bearing interval between the D1 and D2 sequences is not preserved. Thus, to estimate the now-eroded thickness of strata above the D1 turtles, we must project a regionally extensive, isochronous point or bed to adjacent sections and wells to the north and east of Corral Bluffs. The K/Pg boundary is the best datum for this purpose because it has been bracketed by biostratigraphy, magnetostratigraphy and physical sedimentologic evidence in many locations in the Denver Basin, and its position at Corral Bluffs and adjacent, complete, D1-bearing sections and core is well-known (see summaries in Raynolds, 2002; Dechesne et al., 2011; Lyson et al., 2019). Given the isopachs to the north of Corral Bluffs (Dechesne et al., 2011), a projected thickness of 1,500–1,700’ would be anticipated at Corral Bluffs, translating to 488 to 610 m of D1 strata present in the thickest part of the Corral Bluffs succession, or 279 to 401 m of strata above the K-Pg, given projections of sub-K/Pg thicknesses of 209 m from the adjacent RW Lewis #1 well. Given that today there is ~175 m of D1 strata above the K/Pg at Corral Bluffs today, 69-130 m of strata have been removed by erosion. Because there is little well control to support D1 isopach map projections, there is also a possibility that the D1 was even thicker than anticipated; we conservatively place an upper bound of 2050’ or 625 m in thickness because this is the thickest known occurrence of D1 in the region (Dechesne et al., 2011).

*Maximum preserved thicknesses of strata that could conceivably cap the Hell Creek Formation:*

Similar to our rational above, we do not think that all of the units listed below actually capped the Hell Creek Formation, but in order to be conservative in our assessment we treat each unit individually in our burial depth assessment. We focus on units that are exposed in SW North Dakota because we have higher confidence that these units actually capped the Hell Creek Formation. All but three units are exposed in SW North Dakota. Assuming these three Quaternary formations were exposed in SW ND and removed during the last glacial retreat, the total thickness overlying the Turtle Graveyard and Turtle Ridge localities could have been as much as 1,411 m of overlying sediments, whereas if these three formations did not overly the Hell Creek Formation the minimum amount would have been as thin as 990 m – a number that is more plausible given the spatial distribution of glaciogenic evidence in the region. The below units are listed in stratigraphic order, with the maximum measured thickness of the unit in parentheses.

Oahe Fm (30 m): This unit is exposed in the eastern part of North Dakota (Murphy et al. 2009) and we assume it was present in SW North Dakota and subsequently eroded away.

Coleharbor Group (300 m): This unit is exposed in the west central and eastern part of North Dakota (Murphy et al. 2009) and we assume it was present in SW North Dakota and subsequently eroded away.

unnamed unit (91 m): This unit is variably exposed across North Dakota but is not present in SW North Dakota (Murphy et al. 2009). We assume this unit was present in SW North Dakota and subsequently eroded away.

Arikaree Fm (101 m): This unit is broadly exposed and caps many of the major buttes in SW North Dakota (Murphy et al. 2009).

Brule Fm (61 m): This fossiliferous unit is broadly exposed in SW North Dakota (Murphy et al. 2009).

Chadron Fm (43 m): This fossiliferous unit is broadly exposed in SW North Dakota and consists of two distinct members (Murphy et al. 2009).

Golden Valley Fm (122 m): This unit is broadly exposed in SW North Dakota and consists of two distinct members (Murphy et al. 2009).

Sentinel Butte Fm (198 m): This unit is broadly exposed in SW North Dakota and makes up many of the badlands in Theodore Roosevelt National Park (Murphy et al. 2009).

Bullion Creek Fm (130+ m): This unit is equivalent to the Tongue River Formation in pre- 1977 stratigraphic nomenclature (Murphy et al. 2009). Belt et al. (2004) measured 130+ m of section in SW North Dakota and noted it had an eroded top. Murphy et al. (2009) note this unit is 198 m thick.

Ludlow Member of Fort Union Fm. (210 m): Peppe et al. (2009) measured 210 m of section in SW North Dakota.

Turtle Graveyard (DMNH Loc. 6301) and Turtle Ridge (DMNH Loc. 6302) localities within the Hell Creek Fm (56.8 m): These localities are stratigraphically equivalent and are approximately 400 m apart from one another. Both localities are 56.8 m below the Hell Creek/Fort Union formation contact (Lyson and Joyce 2009; Lyson et al. 2019).