



Lower Cretaceous paleo-Vertisols and sedimentary interrelationships in stacked alluvial sequences, Utah, USA



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ARTICLE INFO

Article history:

Received 15 May 2017

Received in revised form 15 September 2017

Accepted 16 September 2017

Available online 20 September 2017

Editor: Dr. J. Knight

Keywords:

Pedogenic slickensides

Gilgai microrelief

Carbonate nodules

Avulsion deposits

Soft-sediment deformation

ABSTRACT

The Yellow Cat Member of the Cedar Mountain Formation in Poison Strip, Utah, USA, consists of stacked, erosionally bounded alluvial sequences dominated by massive mudstones (lithofacies Fm) with paleo-Vertisols. Sediment bodies within these sequences grade vertically and laterally into each other at pedogenic boundaries, across which color, texture, and structures (sedimentary vs. pedogenic) change. Slickensides, unfilled (sealed) cracks, carbonate-filled cracks, and deeper cracks filled with sandstone; the latter features suggest thorough desiccation during aridification. Thin sandstones (Sms) in some sequences, typically as well as laminated to massive mudstones (Fm) with which they are interbedded in some cases, are interpreted as avulsion deposits. The termini of many beds of these lithofacies curve upward, parallel to nearby pedogenic slickensides, as the features we call “turnups.” Turnups are overlain or surrounded by paleosols, but strata sheltered underneath beds with turnups retain primary sedimentary fabrics. Turnups were produced by movement along slickensides during pedogenesis, by differential compaction alongside pre-existing gilgai microhighs, or by a combination of both. Palustrine carbonates (lithofacies C) appear only in the highest or next-highest alluvial sequences, along with a deep paleo-Vertisol that exhibits partially preserved microrelief at the base of the overlying Poison Strip Member. The attributes of the Yellow Cat Member suggest comparatively low accommodation, slow accumulation, long hiatuses in clastic sedimentation, and substantial time intervals of subaerial exposure and pedogenesis; it appears to be distinct among the members of the Cedar Mountain Formation in these respects.

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1. Introduction

The Cedar Mountain Formation (Barremian?–Cenomanian) in Utah, USA is an important terrestrial record of ancient North America (Currie, 1998; Cifelli et al., 1999; Kirkland and Madsen, 2007; Ludvigson et al., 2010, 2015; Kirkland and Farlow, 2012; Kirkland et al., 2016). Of the five members of the Cedar Mountain Formation, alluvial mudstones dominate in the Yellow Cat Member, discussed herein, and in the stratigraphically higher, thicker Ruby Ranch Member (Fig. 1C), which thickens westward to the San Rafael Swell as the Yellow Cat Member pinches out (Stikes, 2007; Kirkland et al., 2016). A detailed assessment of paleosols in any part of the Cedar Mountain Formation has been lacking until now. There is little or no evidence for well-developed paleosol profiles in much of the formation, but exposures of the upper Yellow Cat Member in the Poison Strip area of Grand County,

Utah, USA (Figs. 1, 2) reveal well-developed paleosols with clarity. Our study documents the distinct morphological features of these paleosols and interprets them in terms alluvial sedimentation, pedogenesis, and ancient climates.

2. Setting

The Poison Strip (Fig. 1A, B) is a strike valley in the Upper Jurassic Morrison Formation with the dissected cuesta to the north of the valley exposing the Morrison Formation and the Cretaceous Cedar Mountain and Naturita formations (Fig. 1C). Most observations in this study were made in the walls of two south-southwest- to north-northeast-trending canyons in the cuesta (Fig. 1A: localities 1 and 2). The study area lies in the northern Paradox Basin, a late Paleozoic evaporate basin between two Laramide structures: the asymmetrical anticline known as San Rafael Swell to the west and the reactivated Uncompahgre uplift to the north and east (Fig. 1B). During the early Cretaceous, subsidence around the component Salt Valley anticline probably created accommodation space for the deposition of the

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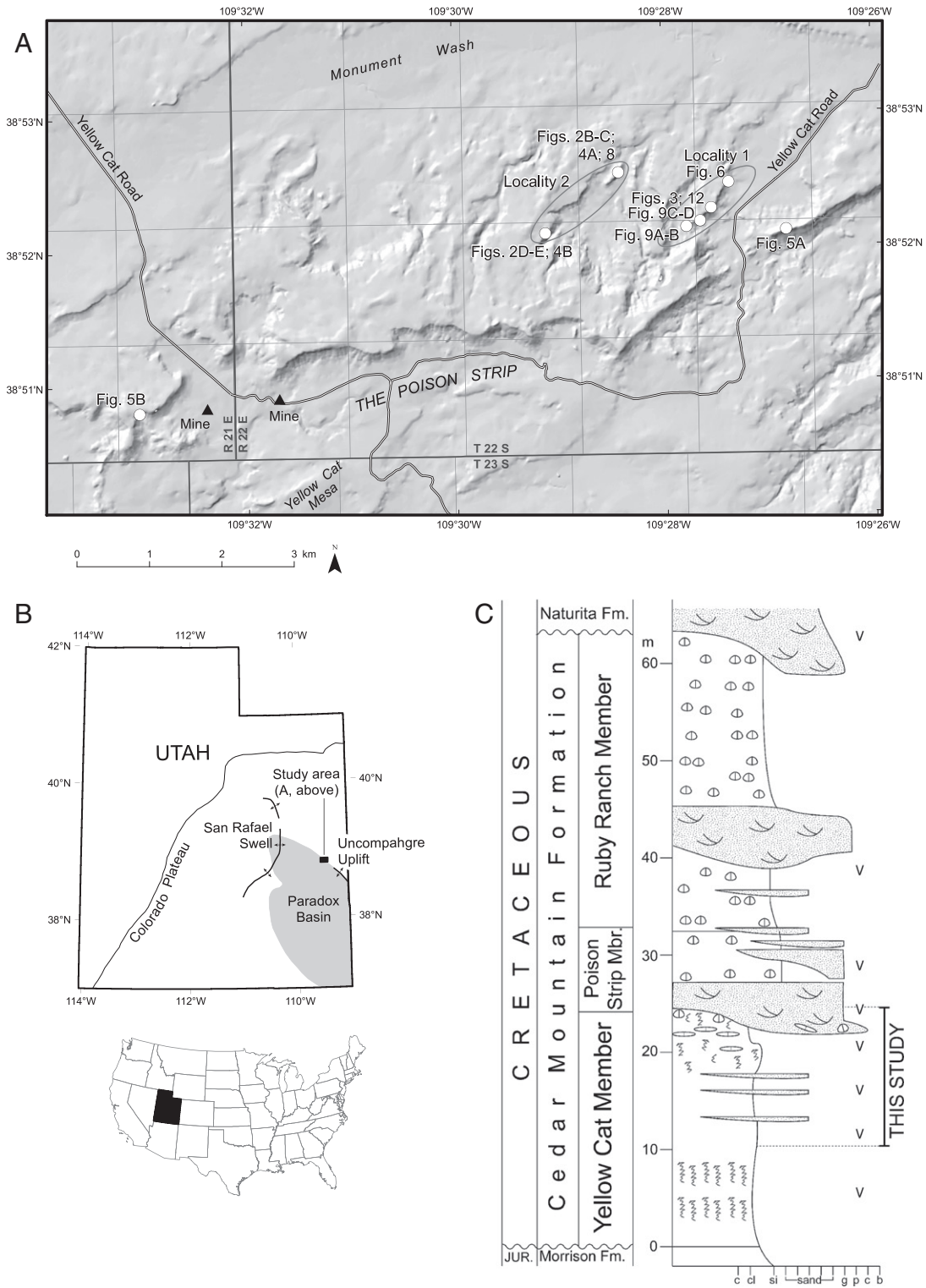


Fig. 1. Map of study area and generalized stratigraphic section of Cedar Mountain Formation. “V” denotes general stratigraphic positions of vertebrate fossil assemblages.

geographically restricted Yellow Cat Member, and the study area was an alluvial to lacustrine plain located east of the rising Sevier Mountains, while streams flowed northwards from the Mogollon Highlands and eastwards from the Sevier Mountains across the Sevier foreland (Kirkland et al., 1997, 2016; Willis, 1999; Currie, 2002; Kirkland and Madsen, 2007; Stikes, 2007; Dickinson and Gehrels, 2008; Lawton et al., 2010). An early Cretaceous orographic rainshadow extended 600 km eastwards from the Sevier Mountains present-day Arizona

into Canada (Hopkins, 1985; Schwartz and DeCelles, 1988; Aubrey, 1998; Currie, 1998; DeCelles, 2004; Dickinson, 2004; Elliot et al., 2007; Ludvigson et al., 2010, 2015; Ross et al., 2017). There is stable-isotope chemostratigraphic evidence for shifts in rainfall during Cedar Mountain times (Ludvigson et al., 2010, 2015). Suarez et al. (2014), in an independent survey of oxygen-isotope signatures in fossil bones, concluded that the foreland was aridified during the late stages of Yellow Cat Member deposition.

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