Sandstone characteristics:

Decimeter-scale trough cross-lamination
Horizontal lamination
Soft-sediment deformation
Meter-scale complex crossbeds; foresets with horizontal topsets.
Poor to fair sorting; angular to sub rounded
Median grain size probably coarse grained to granules with pebbles and cobbles common
Feldspar and quartz
Mudrock rippup-clasts present
Likely dominantly easterly paleocurrent

Interpretation:

Down-stream accreting bars and bedforms
Probably linguoid or side bars
Diagenetic contacts and soft sediment
Deformation can obscure bedding and contacts

by Mark Kirschbaum

Mudrock characteristics:

Discontinuous to continuous
Massive with rare (deformed?) bedding
Fine to medium sand commonly with floating granules
Oxidized to red color but with many reduced zones
Major soft sediment deformation
Basal and upper contacts sharp to erosional with injection features
Lenticular (sigmoidal) sandstone beds commonly enclosed in mud
Roots reported; mudcracks present at tops of beds.

Interpretation:

Diagenetic contacts and soft sediment
Deformation can obscure bedding and contacts
Depositional setting unclear:
- Floodplain?
- Fine-grain debris flows?
- Mudflat?
- Paleosols?

by Mark Kirschbaum

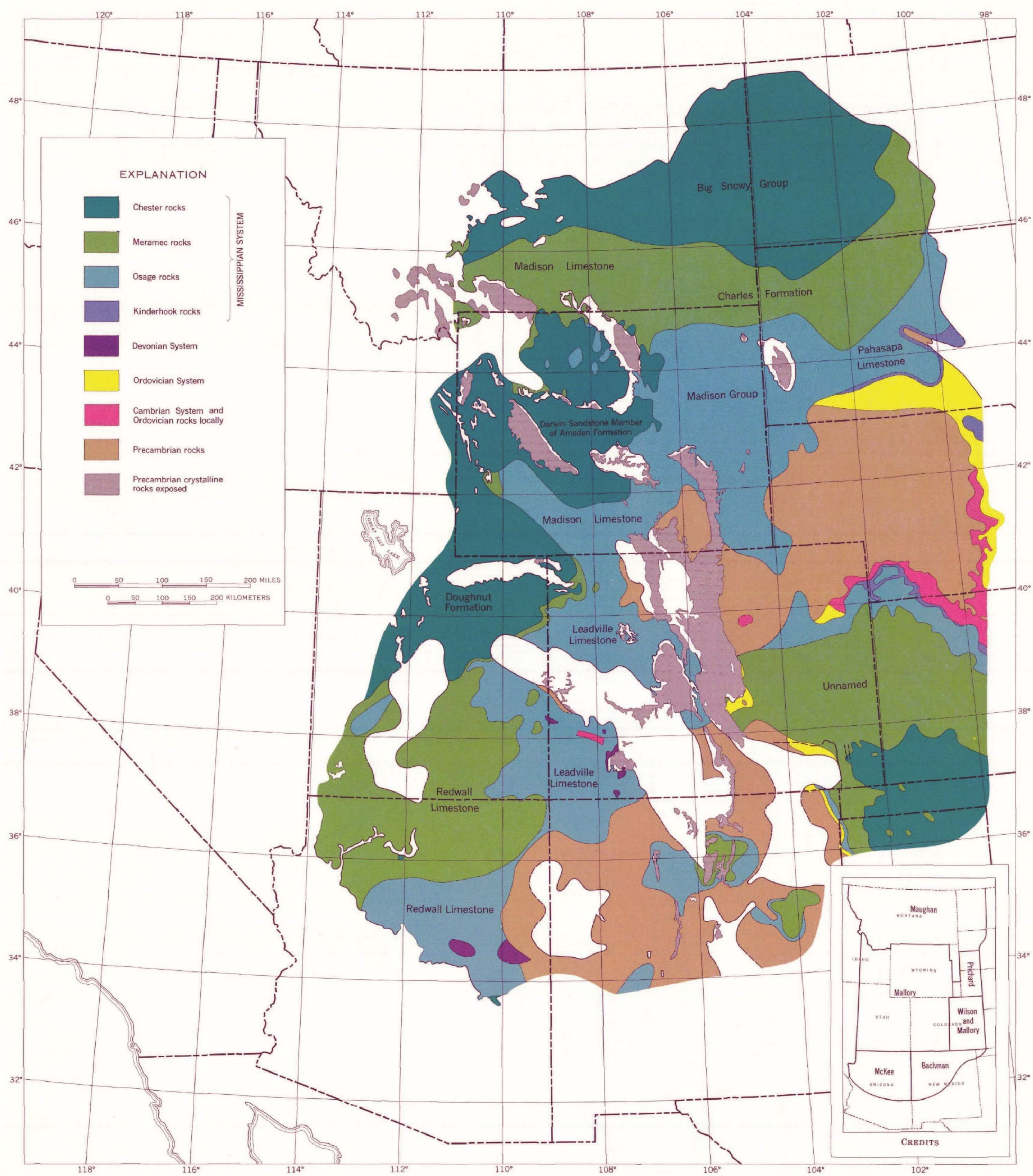


Figure 3:
SUB-PENNSYLVANIAN PALEOGEOLOGY

Pennsylvanian subcrop map from RMAG Atlas

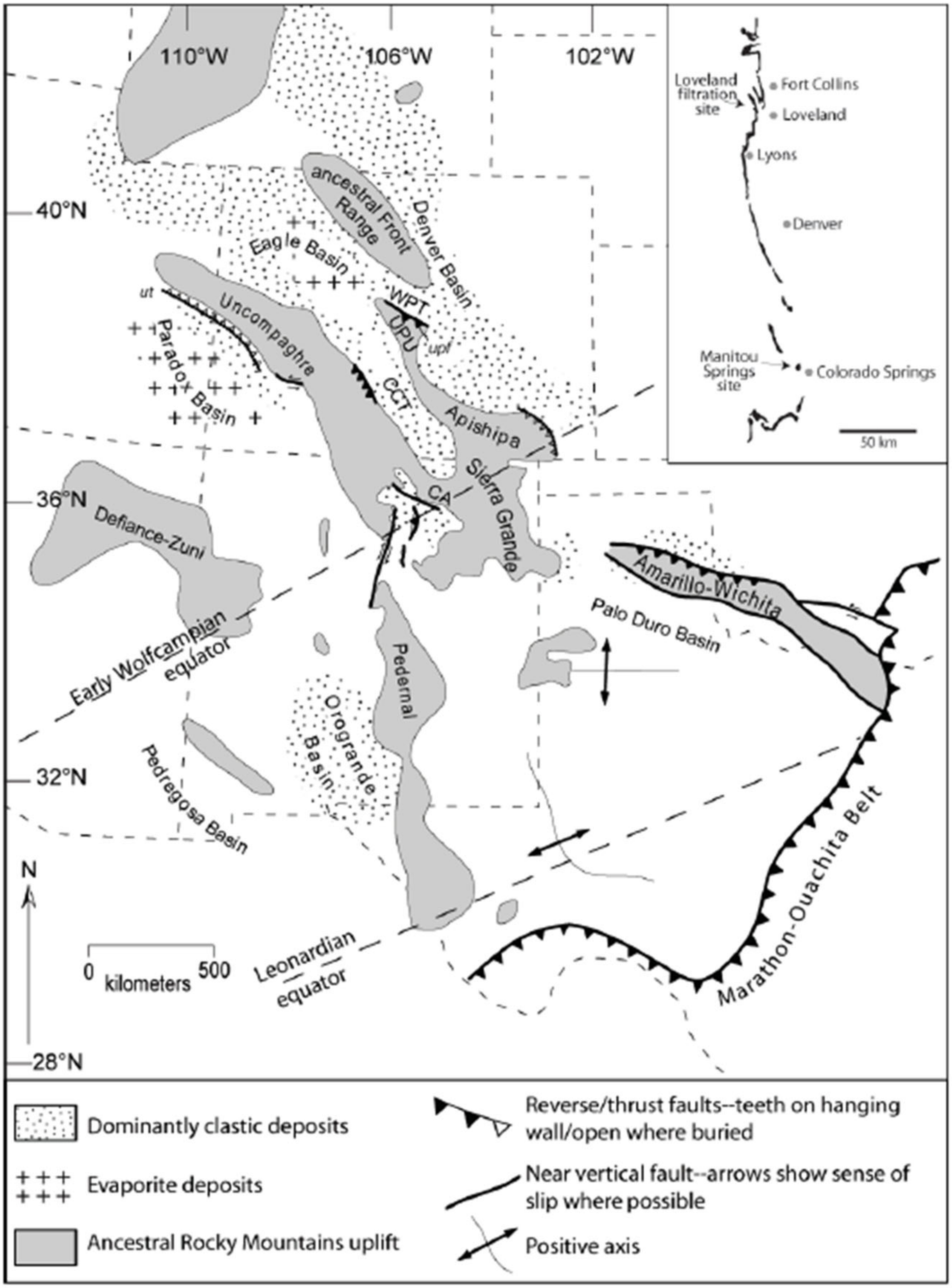
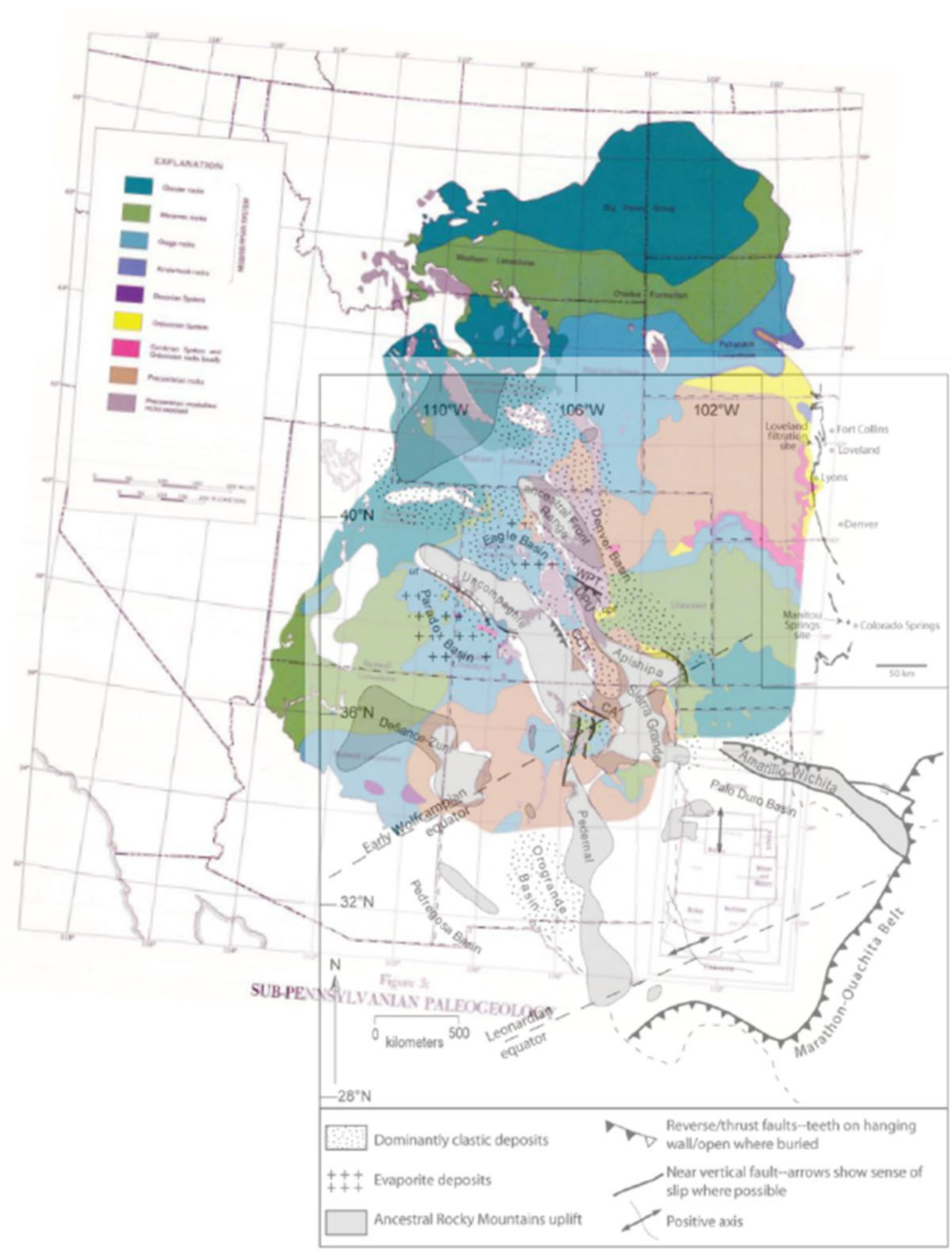


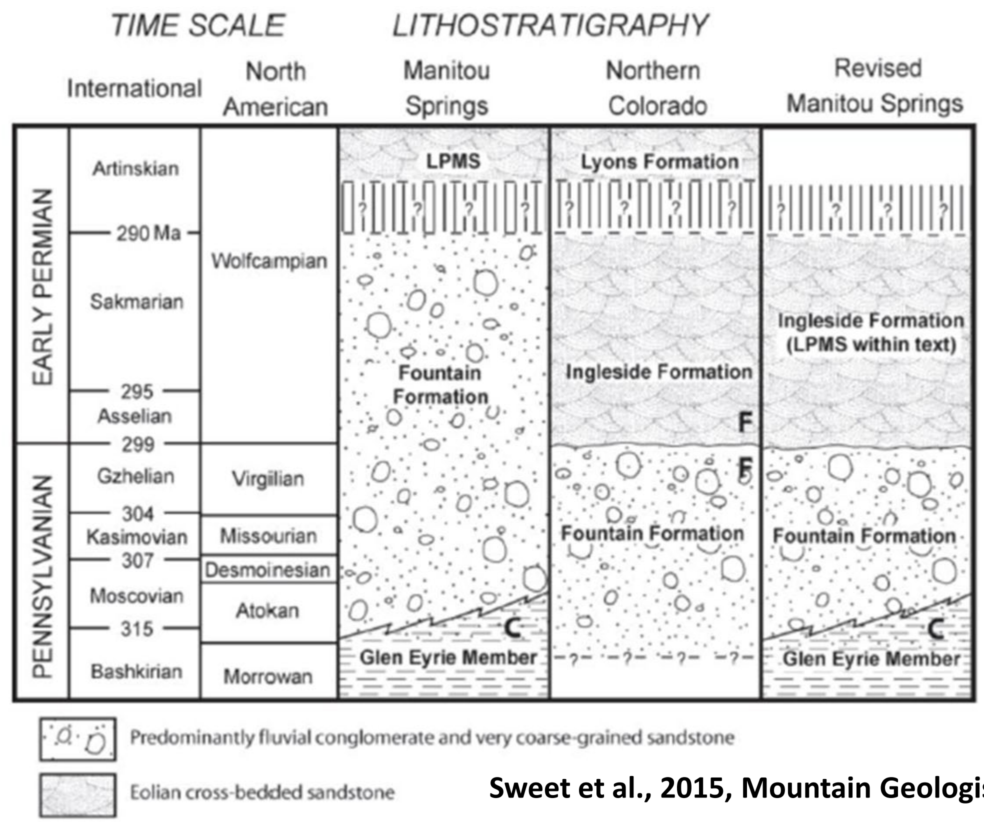
Figure 1. Late Pennsylvanian tectonic elements of the ancestral Rocky Mountains. Data compiled from Lindsey et al. (1986), Hoy and Ridgway (2002), Sweet and Soreghan (2010a), Baltz and Myers (1999). Location of equators estimated from Peterson (1988). Abbreviations—WPT = Woodland Park trough, CCT = Central Colorado trough, CA = Cimarron arch, UPU = Ute Pass uplift, upf = Ute Pass fault. Inset: Location of sites discussed throughout text and Fountain Formation (in black) outcrop along the east flank of Front Range.

Sweet et al., 2015, Mountain Geologist

Pennsylvanian Fountain Formation



Overlay of Pennsylvanian subcrop map from RMAG Atlas and Fountain Paleogeography from Sweet et al., 2015, Mountain Geologist



Sweet et al., 2015, Mountain Geologist

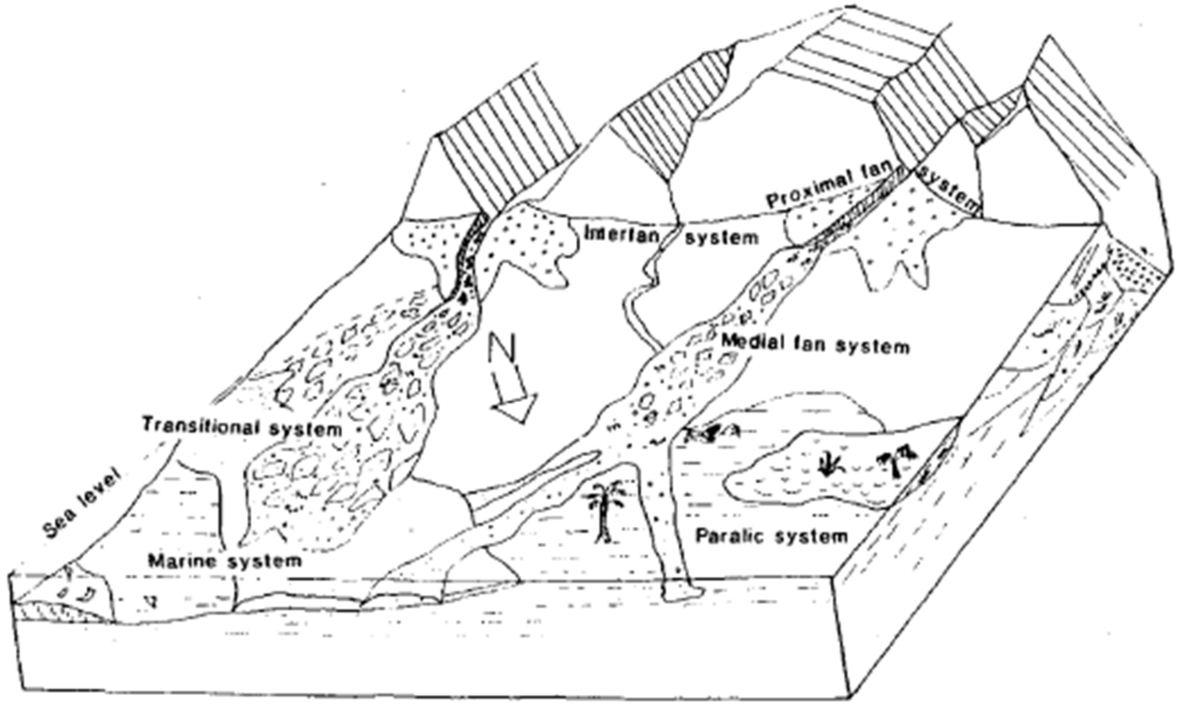


Fig. 12: Block diagram of the spatial arrangement of the major depositional systems in the Manitou embayment during lower Fountain deposition. The paralic system disappeared during the later phases of deposition of the lower Fountain.

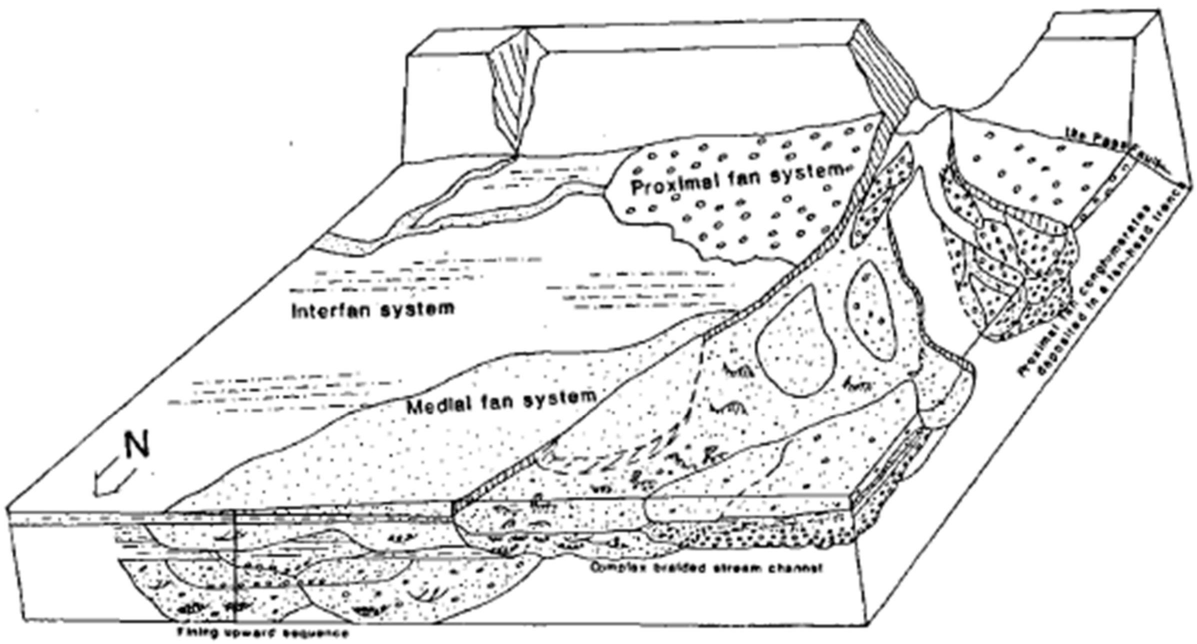


Fig. 13: Block diagram of the proximal, interfan, and medial depositional systems. The proximal and interfan systems had stable locations along the fault scarp. The medial system formed fining-upward sequences through the progressive unfilling of complex braided stream channels.

Langford, R.P., Fishbaugh, D.A., 1984. Sedimentology of the Fountain fan-delta complex near Manitou Springs, Colorado. In: Suttner, L.J. (Ed.), Sedimentology of the Fountain Fan-delta Complex near Manitou Springs and Canon City, Colorado. Society of Economic Paleontologists and Mineralogists field guidebook, pp. 1–30.

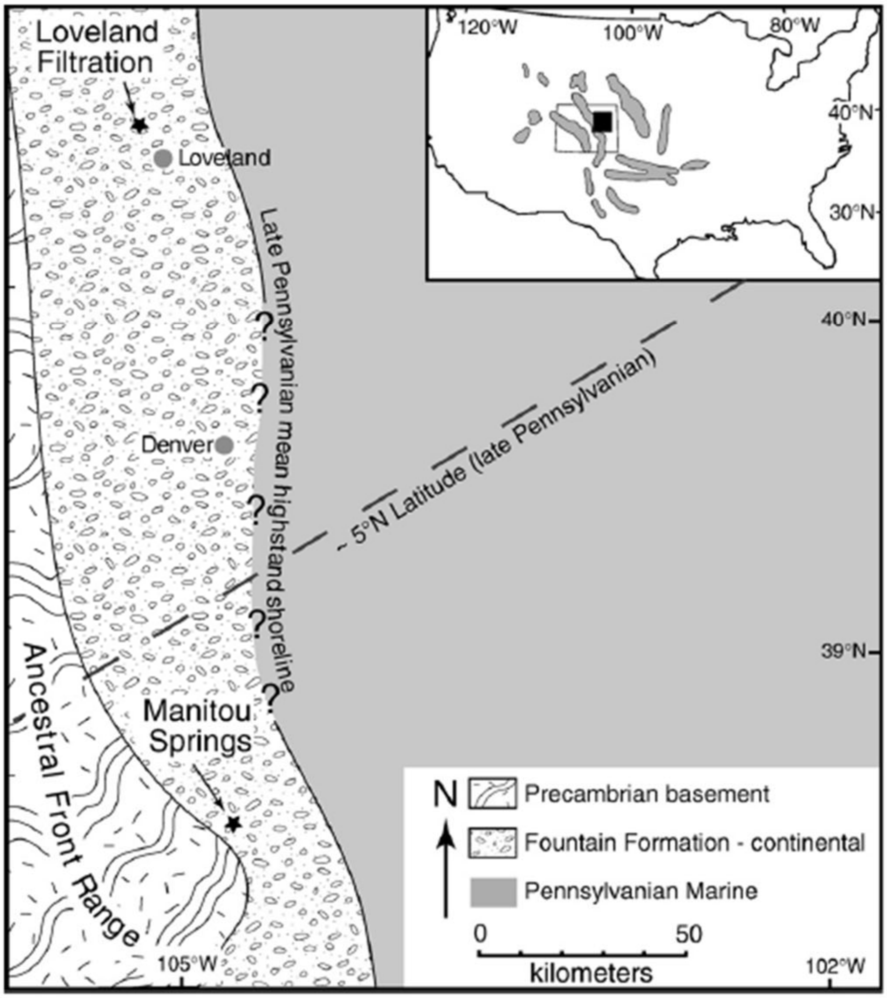


Fig. 1. Late Pennsylvanian paleogeographic map along the east flank of the ancestral Front Range uplift. Manitou Springs and Loveland study sites are denoted by black stars. The average highstand shoreline is estimated from subsurface data of Maughan and Ahlbrandt (1985) and Maher (1953). Latitudinal position estimated from Scotese (1999). Inset: Displays the outline of Colorado within the United States interior and location of ARM uplifts (*in* gray; modified from Kluth and Coney, 1981). Black box is the approximate area of enlarged view.

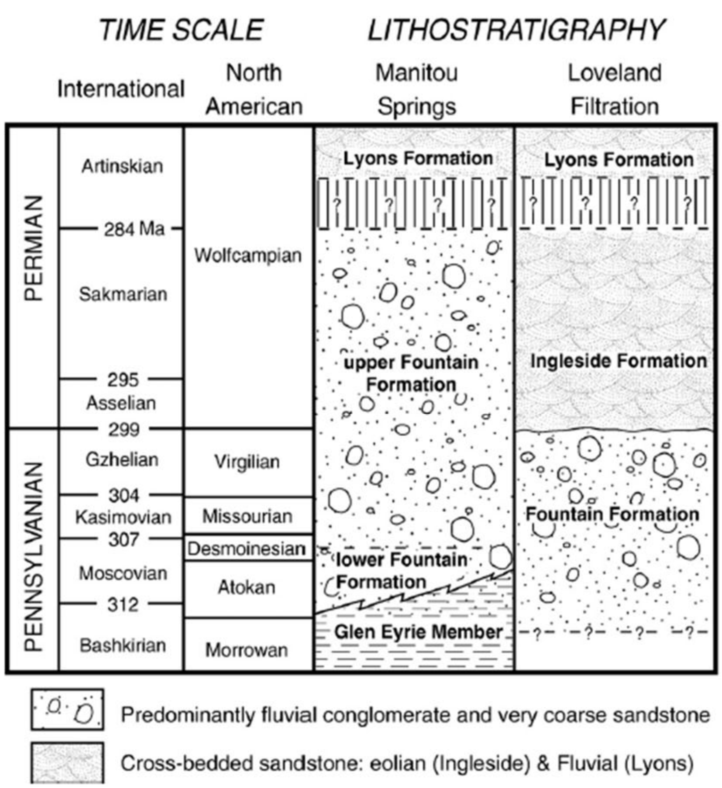


Fig. 2. Late Pennsylvanian–Early Permian stratigraphy along the east flank of the ancestral Front Range uplift. Vertical black lines denote hiatuses. Location of stratigraphic columns shown in Fig. 1 as black stars. Age of lithostratigraphic units at Manitou Springs from Chronic and Williams (1978), Trimble and Machette (1979) and Suttner et al. (1984). Ages of the lithostratigrapic units at Loveland, Colorado are from Maughan and Ahlbrandt (1985). Timescale is from Gradstein et al. (2004).

PALEO-FLUID MIGRATION AND DIAGENESIS IN THE PENNSYLVANIAN-PERMIAN FOUNTAIN FORMATION

The Pennsylvanian-Permian Fountain Formation is an arkosic conglomeratic sandstone that was deposited in fluvial environments along the eastern flanks of the ancestral Rocky Mountains. The formation owes its pinkish red color to hematite cement that was precipitated early in its diagenetic history. Within the formation are whitened strata that crosscut laminations and facies boundaries, indicating that they are the result of a post depositional process. Whitened features are seen in core, indicating that they are not caused by modern weathering processes. Whitened strata similar to those present in the Fountain Formation are usually the result of the migration of reducing fluids. These fluids reduce and remove hematite cement leaving the fluid migration pathways whitened. Fluids that can cause large-scale reduction and removal of iron oxides include basinal aqueous brines and hydrocarbons.

Whitening within the Fountain Formation appears in a predictable stratigraphically-controlled manner and is most common in coarse channel sandstone facies that are adjacent to laterally continuous paleosol mudstones. The predictable distribution of whitened strata in outcrop suggests that fluid followed preferential pathways. Outcrop analysis indicates that these pathways are closely associated with thin paleosol mudstones and overbank deposits that seem to have focused the paleo-fluids that then flowed laterally along them in the coarser channel sandstones. Laterally continuous paleosol mudstones therefore may have played an important role in determining the spatial location of paleo-fluid migration pathways. Fluids moved through the formation as stringers that took up less than 15% of the total rock volume.

Hogan, I., 2013, Paleo-fluid migration and diagenesis in the Pennsylvanian-Permian Fountain Formation: MS Thesis submitted to Colorado State University, 169 p.