Subsurface Architecture Study of Channel Belt Deposits Integrating Field Data and GPR in the Ferron Sandstone, Hanksville, Utah

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INTRODUCTION

- The evolution and subsurface architecture of an ancient channel belt deposit was studied by integrating Ground Penetrating Radar (GPR) and field data in the Cretaceous Ferron Sandstone, Hanksville, Utah.
- Most ancient fluvial deposits are assessed from vertical cliff faces solely leading to possible misinterpretation of changes in channel orientation and erroneous estimation of channel architecture.
- Proper assessment of channel architecture in three dimensions is required for precise estimation of fluvial reservoir volume calculation.

GEOLOGIC SETTING

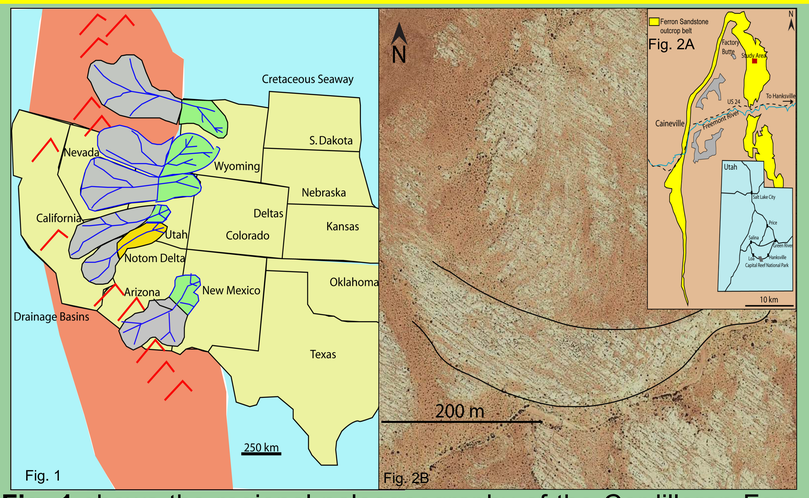
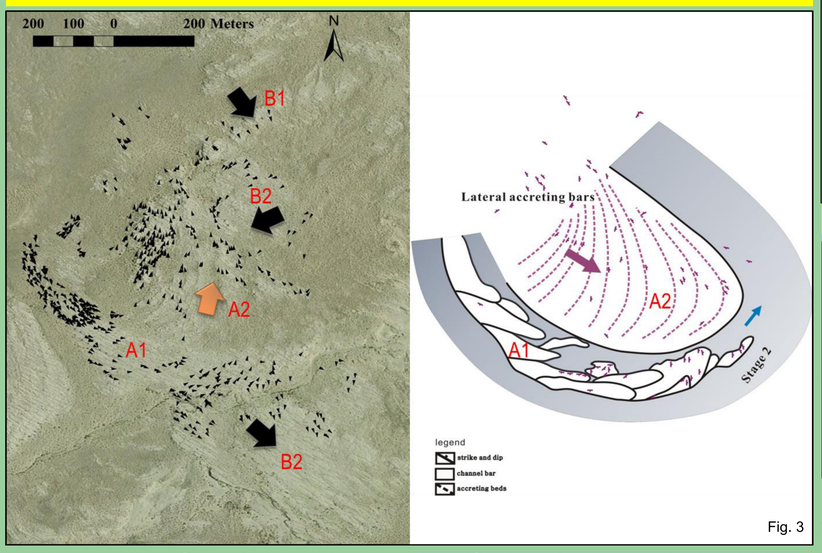


Fig. 1 shows the regional paleogeography of the Cordilleran Foreland Basin during Turonian.

- There are three delta complexes within the Ferron Sandstone, Notom, Vernal and Last Chance deltas.
- Study area is part of the Ferron Notom delta which is exposed in the south-east part of Utah, near Hanksville.

Fig. 2A shows the extent of Ferron sandstone in the study area.
Fig. 2B shows the Google Earth image of the study area

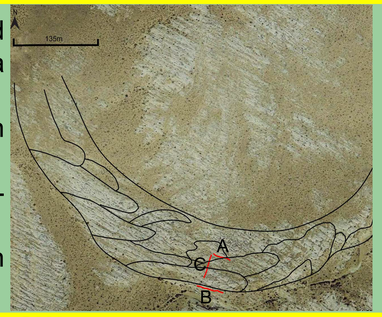
PREVIOUS WORK



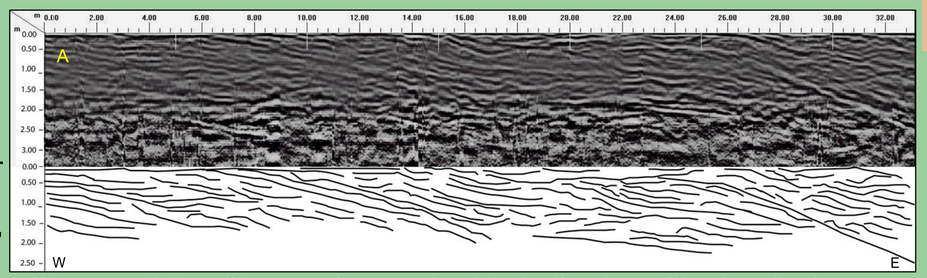
- The studied fluvial deposit was identified as large-scale braid bar deposits based on paleo flow and grain size variation (Wang, 2013) (Fig. 3)
- In this study a GPR survey was conducted on this channel belt deposit in order to document the shallow subsurface architecture.

DATA and METHOD

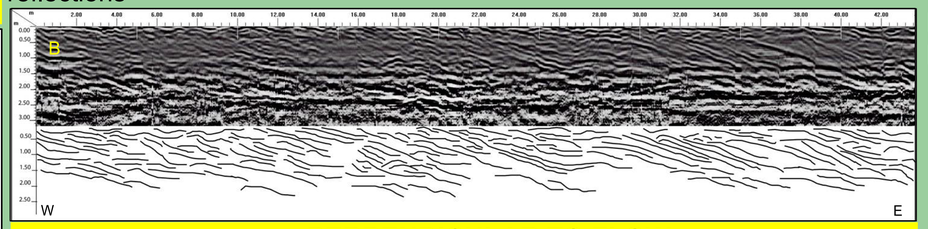
- Six GPR profiles, four flow parallel and two flow transvers, were collected using a 200MHz antenna.
- The GPR data were processed in RADAN software.
- GPR data was integrated and interpreted in the Adobe Illustrator.
- Fig. 4 shows locations of GPR lines on the channel belt



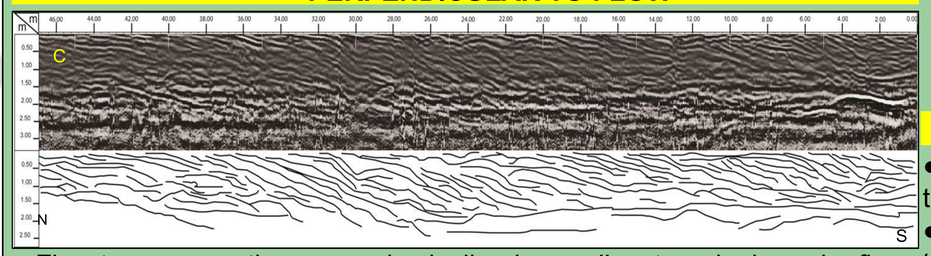
PARALLEL TO FLOW



- Flow parallel profiles are characterized by inclined stratification dipping parallel to the flow direction i.e. towards east.
- Length of the reflections increases towards east.
- Unit bar boundaries are marked by >10m long, ~1.5m deep, and continuous reflections

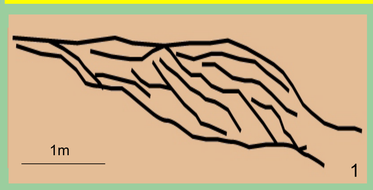


PERPENDICULAR TO FLOW



- Flow traverse sections comprise inclined as well as trough shaped reflections.
- Inclined reflections are dipping towards south
- Length of radar reflection increases southward

GPR FACIES AND INTERPRETATION



Facies 1: 0.1-0.5m long numerous reflections bounded by >10m long continuous surfaces on both sides making an en-echelon pattern.
Interpretation – Downstream migrating planer cross-stratified foresets (Horn et al., 2012).

Facies 2: Isolated sets of 2m deep and 10m or smaller surfaces bounded by >10m long continuous surface
Interpretation – Secondary channel scours and fills (Horn et al., 2012).

Facies 3: Isolated convex up 3-5m long and 0.1-0.5m deep reflections (Horn et al., 2012)
Interpretation – Small scour surfaces formed by bar top hollows.

PALEOHYDRAULICS

Paleohydraulic parameters were derived from GPR data. Mean dune height was calculated by averaging the length of the smallest reflections (0.1-0.5m). In this calculation, average velocity has been estimated 1m/sec, based on previous work. Equations have been derived from Wu et al., 2015.

Parameters	Value
Mean Dune height	0.3 m
Mean Flow Depth	4.2 m
Channel Width	122 m
Mean Velocity	1 m^2/S
Mean Discharge	195 m^3/S

REMARKS

- This radar stratigraphy can be correlated with the surface stratigraphy recorded in previous study.
- Future work will involve extrapolation of this facie characterization to fluvial deposits that are solely exposed in plan-view
- Paleohydraulic parameters are comparable with previous study except the channel depth. As smallest reflections are assumed to be dunes, there is a possibility for overestimation here

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