Subsurface sequence stratigraphic correlation using well logs

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Subsurface well logs (gamma and resistivity) are used to construct a cross section based on sequence stratigraphic principles. In this assignment, students will learn how to correlate well logs applying basic concepts of sequence stratigraphy.

Context

Audience: Upper-level undergraduate to graduate level course on sedimentology & stratigraphy.

Skills and concepts that students must have mastered: Students should have basic ideas of geophysical well-logs, particularly, gamma and resistivity logs, and a good understanding of sequence stratigraphic concepts.

How the activity is situated in the course: This activity is part of lab or regular course assignment given late in the course.

Goals

Content/concepts goals for this activity: Sequence stratigraphy

Higher order thinking skills goals for this activity: Pattern matching, converting geophysical signals to earth-model.

Other skills goals for this activity: Working through 'multiple-working-hypothesis', but, at the end, defending individual interpretation.

Description of Activity

Students are given hard copies of a subsurface section containing gamma and resistivity logs of nine closely-spaced (well distance varies from 1 to 3 km) wells from Delaware Basin, southeast New Mexico for an interval of ~ 200 m clastic succession of Morrow sandstone of Pennsylvanian age. Core sedimentology of one of these wells is also provided. Students' task is to correlate the well logs to generate a stratigraphic cross-section of the area using sequence stratigraphic approach.

As the data are from Delaware Basin, southeast New Mexico, student should first gather the knowledge of regional setting of the basin, with a particular emphasis to the paleo-eustasy. (Clue: in Delaware Basin, Morrow sandstones deposited in a low accommodation settings with high-amplitude fluctuations of sea-level.)

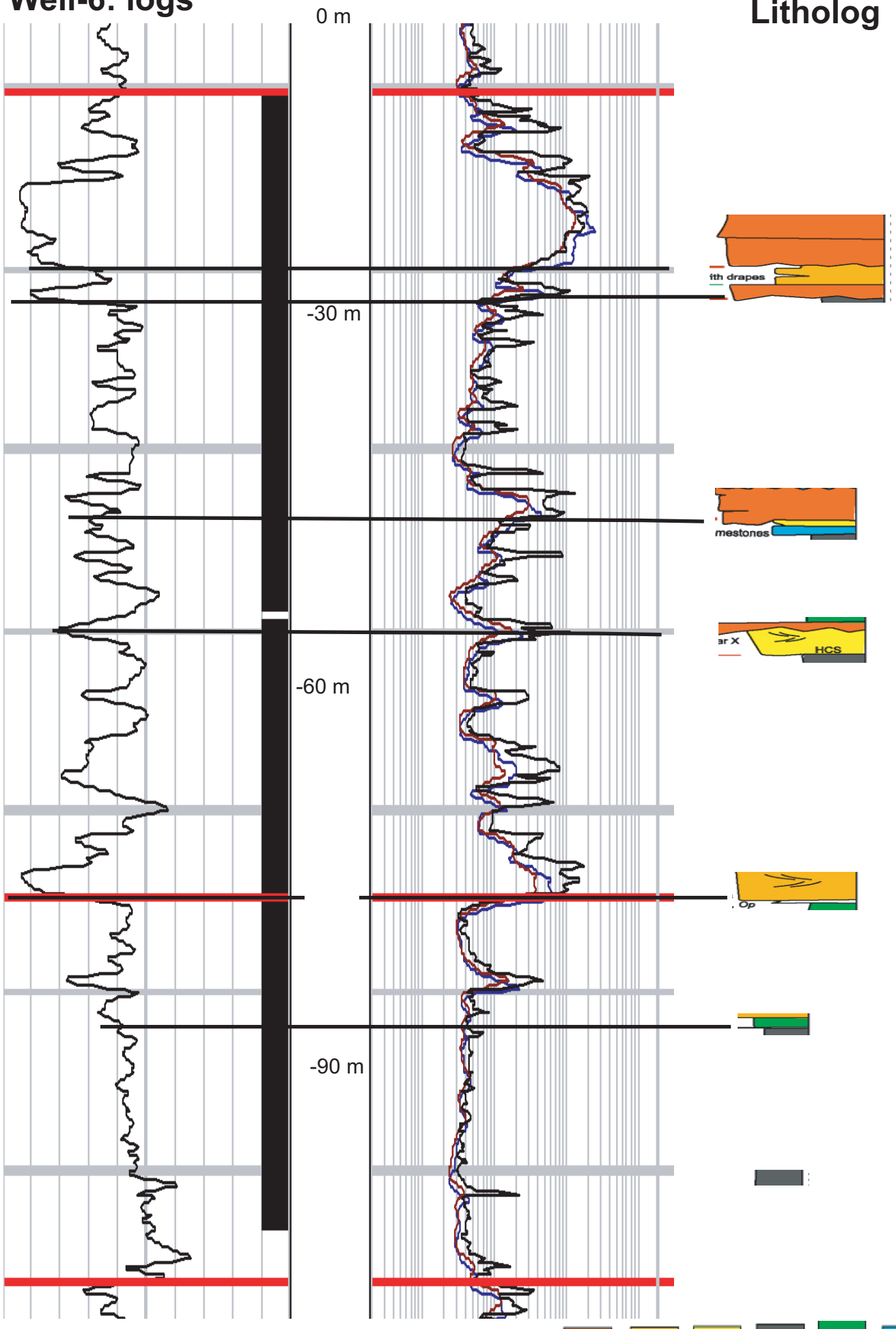
When correlating the well logs students should start with the well which has lithological information. Students should try to correlate the mudstones first. The two most prominent sequence stratigraphic surfaces with comparatively higher correlation-length are ‘sequence boundary’ produced by pronounced fall of sea-level, and ‘maximum flooding surface’ generated at the time of highest stand of sea-level. Students should pay particular attention to incised-valley-fill deposits.

After completing the correlation, students should check whether their correlation satisfy our prevailing ideas of sequence stratigraphy and stratal packaging. Student should prepare a brief description of overall depositional environments and sea-level history of the area substantiating their subsurface correlation.

By doing this exercise, students will learn how to apply sequence stratigraphic principles in interpreting subsurface data, particularly from well logs.

Determining whether students have met the goals:
Students need to turn in correlated cross-section and a one-page written report on the subsurface sedimentology in support of their subsurface interpretation.


Curve Legend
LOG CURVES
0 200 GR (GAPI)
0 200 GRD (GAPI) GAMMA RAY FROM DENSITY LOG
-10 50 IDID (OHMM) 16 DEEP INDUCTION
-10 50 ILD (OHMM)
-10 50 IDIM (OHMM) 4 MEDIUM INDUCTION
-10 50 ILM (OHMM) INDUCTION LOG MEDIUM RESIST
-10 50 LLD (OHMM) LATEROLOG DEEP
-10 50 LDLD (OHMM) 4 FRD
-10 50 LLS (OHMM) LATEROLOG SHALLOW
-10 50 LDLS (OHMM) 5 FOCUSSED RESISTIVITY
-10 50 LLLL (OHMM) 4 FOCUSSED RESISTIVITY
-10 50 LLUN (OHMM) 5 FOCUSSED RESISTIVITY
North
South
Well-1
3 km
Well-2
3 km
Well-3
1.5 km
Well-4
1.5 km
Well-5
1.5 km
Well-6
1.5 km
Well-7
2 km
Well-8
1.5 km
Well-9
Depth m
30
0
-30
-60
-90
-120
-150
Datum
Datum
Datum
DNGR
LDLS
LDLD
IDIM
IDID
GR
ILM
ILD
ACGR
LLUN


Well-6: logs
Litholog
0 m
-30 m
-60 m
-90 m
ith drapes
mestones
HCS
Op
Sandstone Non-marine
Sandstone transitional
Sandstone marine
Mudstone marine
Mudstone transitional/ non-marine
Limestone