LATERAL CORRELATION TRENDS IN BEDDED AND MASSIVE TURBIDITES, WITH AN EXAMPLE FROM DE GRAY LAKE, ARKANSAS

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ABSTRACT

Data collection methods for modern and ancient turbidite systems are necessarily different. Therefore, the integration of data sets from both types of systems is desirable if lithofacies and surface morphological models are to be linked. To achieve this, two activities have to be dealt with: 1) Outcrops in ancient turbidite systems must be correlated laterally in sufficient detail to establish a framework to facilitate the interpretation of subenvironments which build the turbidite system, and 2) modern and subsurface turbidite systems must be extensively cored and described. The first approach can be accomplished only in a few turbidite systems that are relatively well exposed, with outcrops exposing thick sections of turbidites which have an equally thick correlative.

One ancient turbidite system meets the above criteria. It is the Pennsylvanian age Jackfork Group exposed around DeGray Lake, Arkansas. Two correlatable outcrops form the east and west wall of the spillway, 214 feet (65 m) apart, while the third outcrop is 5500 feet (1675 m) to the west near the intake for the power-generating dam.

Each outcrop was divided into lithofacies units. Each unit was then described in general terms and individual beds were measured. The major units established a rough correlation between large segments of each outcrop using changes in character. This produces a more detailed assessment and quantification of changes than is obtained when the units are divided into small subunits. Stratigraphically-thick sections of beds can often be correlated between spillway walls. This is difficult to accomplish using lithologic logs derived from measured sections. Correlation was found easier when the sandstone bed thickness values were plotted on a graph such as shown in Figure 1. Each successive bed is weighted the same on the vertical scale, and the horizontal scale represents bed thickness. The thinner beds, represented by the left-deflecting spikes, show no characteristic pattern and do not necessarily follow the same trend as the thicker beds, represented by the right-deflecting spikes. The beds in units or subunits can often be divided into thickening-upward, thinning-upward or symmetrical sequences or cycles. These cycles form distinctive patterns for each outcrop and unit. Pattern recognition can be used to correlate between outcrops, similar to the correlation of subsurface well-logs. Individual beds which make up each cycle may then be correlated across the spillway. This method allows for important lateral lithofacies changes and thinning/thickening trends to be recognized.

The lower one-third (approx. 140 feet [42 m] thick) of the spillway section overlies massive channel deposits. The thinning- and fining-upward nature of these beds and their position over channel deposits make these interpretable as a channel-levee-overbank succession. Paleocurrent direction for the channels in this part of the Jackfork Group is westerly. Detailed correlation of individual beds, using a plot similar to Figure 1, reveals a general thinning of layers and an increasing degree of correlatibility upward, from 40 percent in the lower part to over 80 percent in the upper part of the section. This increase may reflect more laterally-extensive, sheet-type flow deposition.

The second section is relatively thick-bedded and is sandwiched between very thin-bedded distal overbank deposits. This section is interpreted as a depositional lobe deposit. Thickening-upward cycles can be recognized and used for correlation between spillway walls. Individual bed and cycle thicknesses for each cycle show thinning trends across the spillway that switch back and forth in direction, comparable to compensation cycles. A correlative section of turbidites at the intake also shows thickening-upward trends. The overall thickness of the spillway sections is about 80 feet (24 m) thick while the intake section is much thinner (about 51 feet or 16 m thick). Paleocurrent directions measured from sole markings show that this section is slightly oblique to directly down-current of the spillway. Figure 1 shows good overall correlation between spillway sections and the intake section, but relatively poor bed-to-bed correlatibility.

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The third section is 14 feet (4 m) thick and comprises thicker-bedded turbidites which are thinning-upward and are sandwiched between very thin-bedded basin plain or distal overbank deposits. This section is interpreted as a small channel deposit. The thicker beds typically split into several low-angle amalgamations. A correlative section at the intake is slightly thicker, but is thinner-bedded and shalier. As in all sections, the original correlation was based upon lithofacies. The thickness plot for this section shows that the beds included in the overbank deposits at the spillway can be correlated with thicker beds in the upper portion of the intake section. This is evidence that the parent channel axis lies nearer the intake. Paleocurrent measurements derived from sole markings indicate a westerly direction of flow, but those from cross-lamination are more southerly. This divergence may be characteristic for levee-overbank deposits.

The fourth section is generally fining-upward and is extremely difficult to correlate in detail. Thicker beds at the base of this section can be seen to amalgamate and split within each outcrop. The thicker beds are massive and slurry, and debris-flow deposits are common. These channel-fill beds are extremely difficult to correlate using the thickness plot, although this section shows the same vertical thinning-upward trend in both sides.

Field studies on the parallel outcrops of the Jackfork Group in the DeGray Lake spillway clearly demonstrate that direct correlation of individual layers is not possible because of rapid lateral changes that can occur. However, pattern recognition works well. This example also demonstrates that the degree of correlation may be a means to better identify the depositional subenvironment.

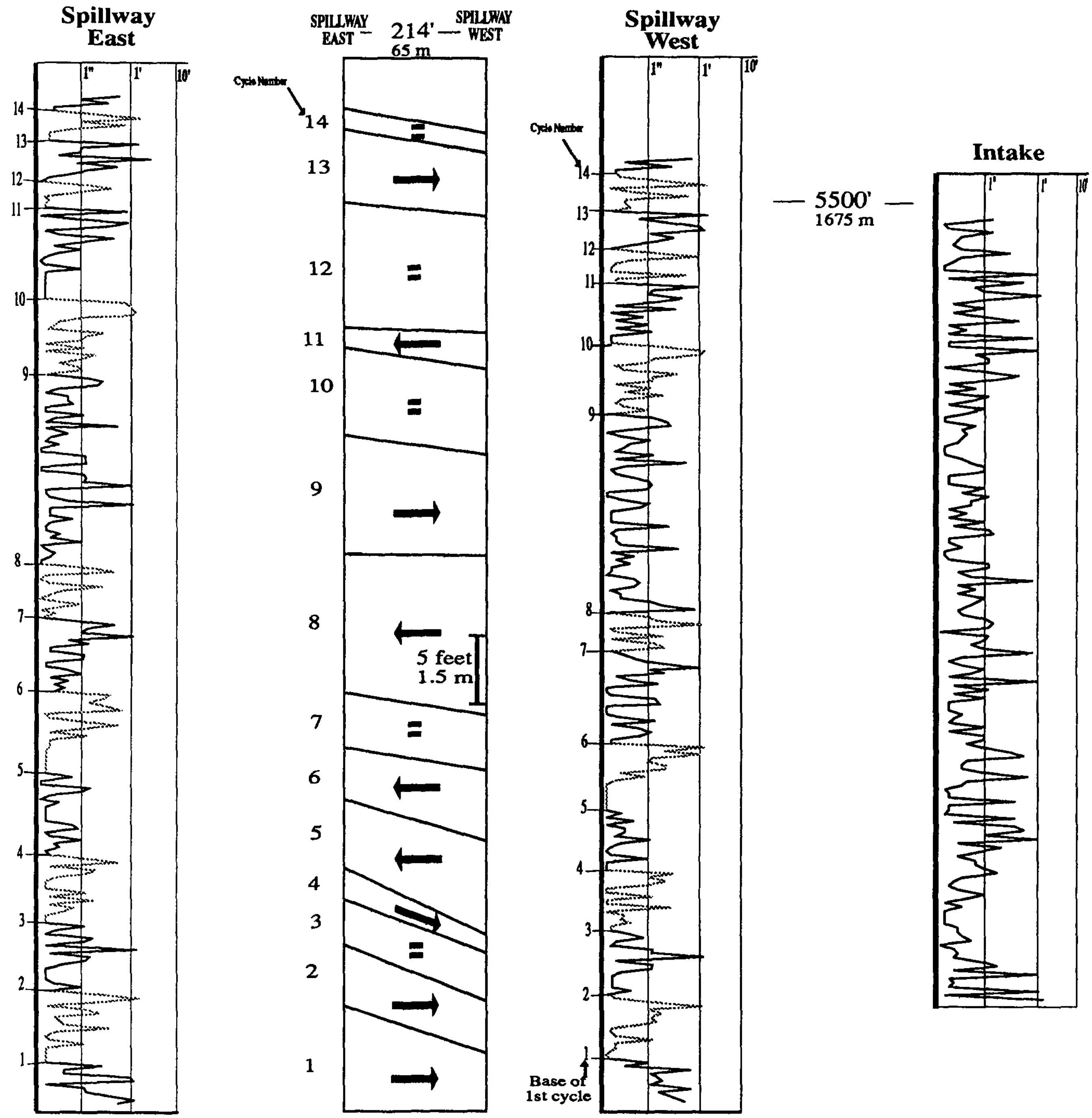

Figure 1. The thickness plot for the sandstone beds in section two was subdivided into cycles which are numbered. Solid and dashed lines are used for successive cycles to ease correlation between east and west sides of the Spillway. Individual beds are weighted the same on the vertical scale with the horizontal scale representing bed thickness. Notice that this scale is not linear, but close to logarithmic. Individual bed correlation is acceptable between the east and west Spillway sections, but poor between the Spillway and Intake sections except in overall thickness trend. The graphic between the thickness plots for east and west Spillway sections shows cycle thickness on the vertical scale. Arrows show direction of thinning which switches back and forth. Equal signs are assigned to cycles which show negligible lateral thinning.