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The Recovery and Utilisation of Vintage Dip Data for Use in Modern Interpretation Environments.

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SUMMARY

Vintage dipmeter and borehole image data are sometimes overlooked, often simply because they do not exist as digital data. However, the data can prove to be a highly valuable and re-usable asset for geologists working in the petroleum industry. The paper will briefly review historic dipmeter and imaging tools and the data types that may be encountered, outlining the ways in which data can be “rescued” and subsequently utilised for re-evaluation and integration using modern tools for analysis in a multiwell 3D context.

Introduction

Formation dip has been analysed from borehole data ever since the Schlumberger brothers and Henri Doll first described “The electromagnetic teleclinometer and dipmeter” in 1933. The 80 years since then have seen the development of many different dipmeter and borehole imaging tools, and today borehole image logs are routinely acquired using optical, electrical, acoustic or nuclear logging principles. Coupled with the huge advances seen in measurement techniques, recent years have seen step changes in computing technology, which have culminated in wide accessibility to image processing and interpretation. Processing and interpretation that used to require specialist software and expensive workstations is now routinely undertaken using PC’s and laptops. Given this high level of technology, and the impact of modern high resolution borehole images, it is very easy to overlook the wealth of vintage data existing in archives. These archives comprise datasets from basins throughout the globe, and there are literally thousands of old dipmeter surveys, which are capable of providing highly valuable geological information. The earliest data forms may only be preserved as paper copies, and vintage log formats and presentation styles may vary significantly. For example, the results of continuous 3-arm dipmeter data computations from the 1960’s are sometimes found only as summary annotations on log composite plots in end of well completion reports. Data from 1950’s vintage diplogs may exist as even sparser listings. However both can be valuable in helping reveal important dip trends or structural breaks in a succession.

The paper will provide a brief historical review of dipmeter and imaging technologies, describing the various types of vintage data you may encounter, and the ways in which it can be “rescued” and subsequently utilised for re-evaluation and integration as part of an analysis using the most modern interpretation tools available.

Method

In terms of a definition, we suggest that vintage dip data might include:

- Dip data which never existed as digital data.
- Dip data which no longer exists as digital data.
- Dip data which exists as digital data on problematic media.

Data sets from the 1950’s–1990’s could thus typically qualify as vintage data. Very early measurements were only recorded as prints (as tabulations or glyphs on film or paper), and their preservation is only as good as the maintenance of physical archives through the decades. Following a digital revolution in the 1960s, data were increasingly preserved as both digital field tapes and also as paper computed listings and prints. However, many data sets acquired after this time simply no longer exist on digital media. The large data arrays of the rapidly evolving dipmeters and borehole images often failed to be accommodated in corporate data stores, and in some cases there has been a loss of original raw data or subsequent processed files.

Vintage data can be recovered in the following ways (Figure 1)

1. Processing/recovery of digital data from archived tape media.
2. Recovery of paper based results
 - a. The rescue of vintage dip solutions (typically automatic computed processing results) by digitisation of tadpole displays.
 - b. Transcription of data listings.
 - c. The reconstruction of digital dipmeter or image logs from appropriate scaled prints.

Recovery of digital data or
computed dip data from
archive tapes or files

Digitisation of vintage dip
computations from prints

Transcription of vintage dip computations

STA- TION	Dipth Interval	Dipth Interval	Dipth Angle	FROM MAGNETIC NORTH			FROM TRUE NORTH				
				Course No. 1	Displacement of curves in reference to 1	Direct ion	AVERAGE DIRECTION	AV DIP	Graph of Direction		
1106	90	2	3	190	01.4	D0.4	121	29	S-4.7-E	29	
1740	315	2	5	252	02.3	D1.7	156	40	S-15-E	40	
2710	323	3	5	48	D8.0				S-1-E	49	
3425				360	D10.7						
3460	302	3	4	360	D13.9						
3735				65	D15.5						
3348	232	4	3	67	D16.4						
4115											
4352	311	4	8	340	0						
4476											
4480	302	4	1	76	D14.7						
4591											
4807	308	4	4	132	D3.5						
				118	D3.0						
4836	307	4	3	119	D3.0						
5282				122	D6.3						
				132	D1.0						
5304	320	5	4	65	D6.5						

Reconstruction of image logs from prints

Figure 1 Simple illustration of vintage dipmeter and borehole image data types and how they may be “recovered” for use in a modern interpretation environment.

Recovery of data from vintage tapes is often complex, as there may be problems loading files because of things like historical stripping or de-multiplexing, incorrect historical file editing, removal of header information, loss of curve unit information etc. The recovery process can often involve considerable detective work, but matching recovered data and processing results with vintage prints helps the process. A significant level of knowledge concerning the data type, curve naming conventions and the vintage tool configuration may be required.

Digitisation and transcription of data are much more straightforward, and we have found that even quite low quality prints or scans with data presented at dense scales can yield surprisingly good results. However, the results do need to be thoroughly reviewed before use in an interpretation, e.g. dips should be examined at a variety of scales and QC'd in the context of hole conditions, tool sticking, hole deviation and the computation parameters cited on log headers, to ensure that the results are valid and useful. Appropriately scaled vintage prints can be used to reconstruct a digital image log that can be used for subsequent analysis and manual dip-picking, and our analyses indicate the dip picks generated from such are typically very good.

Having rescued vintage data, its review in a modern 3D interpretation environment allows geoscientist to interact with and interrogate data to a degree that was simply not possible with the original 2D plots. This can enable far more advanced interpretations of the data than may have originally been possible, and becomes especially useful where multi-well data-sets are available for 3D analysis. Furthermore, it might be fair to state that in some areas, vintage dipmeters were acquired at a high frequency, perhaps much more so than their more modern and more expensive image log counterparts. In this respect they can form a prolific dataset.

Areas where we see vintage data being used include:

- Areas of poor seismic imaging,
- Basins being re-explored, perhaps after many years, in the light of new data or exploration strategies or play types.
- Where the vintage data can supplement models constructed using more modern data, and provide data points which help constrain inter-well models. E.g. helping to model possible fault intersections between wells in field development scenarios where a “surprise” occurs, and the ability to revisit and interrogate vintage data becomes important to infill “gaps” in the model.

Conclusions

Vintage data sets can often be overlooked, often simply because they exist only in print format. However, they can be rescued, and modern dipmeter and borehole image interpretation tools can add value to even sparse vintage data. Even low density vintage dip data from historical offset wells can provide valuable geological control points to add confidence to a 3D model or map, or help solve geological issues that may have been identified in a field with a long history.

References

Schlumberger, C., Schlumberger, M. and Doll, H.G. [1933] The electromagnetic teleclinometer and dipmeter. *Source 1st World Petroleum Congress*, July 18-24, 1933, London, UK. 424-430.