#### Case study: Asia

## Baker Hughes ≽

# INTeX detected cement bond and avoided well remediation costs

A major operator in Asia was working to abandon a land well and needed to ensure zonal isolation in critical areas. A known challenge would be detecting the existing light-weight cement bonding behind the pipe.

A light-weight cement slurry with glass beads had been used in the well. Cement behind the pipe had approximately 6 months of curing time in a conventional casing. Expected cement strength modeled in the laboratory was 700 psi, but a lower figure was anticipated due to possible contamination. The wellbore was filled with water-based mud (WBM) of 10.2 ppg. It would be important to confirm the presence and assess the quality of the cement over two key zones located behind a large 13<sup>5</sup>/<sub>8</sub>-in. 88.2# casing.

Baker Hughes proposed using its Integrity eXplorer<sup>™</sup> (INTeX<sup>™</sup>) cement evaluation service in combination with Baker Hughes Segmented Bond Tool<sup>™</sup> (SBT<sup>™</sup>) well integrity evaluation service for this operation.

INTeX was the optimal choice because it uses shear waves that respond only to solids and can accurately detect cement slurry densities. Its patented electromagnetic-acoustic transducer (EMAT) sensor technology obtains measurements across the widest range of cement weights in the industry—including weights as low as 7 ppg. INTeX provides shear, Lamb, and variable density log (VDL) measurements to determine cement bond and microannulus, without requiring a pressure pass. INTeX provided a shear measurement in a pad tool configuration using EMAT to clearly detect the cement bond behind the casing.

The SBT has fully collapsible, motorized arms that can be run through varying sizes of tubing, opened to log the exposed casing section, and closed to safely extract the tool out of the borehole. The SBT quantitatively measured the cement bond integrity in six angular segments around the casing to deliver information needed to confirm hydraulic isolation. This data was used to accurately assess whether remedial work would be required prior to executing completion.

The combination of Baker Hughes services successfully detected the light-weight cement behind the pipe. The shear and lamb wave attenuation measurements showed cement bond in tandem with the variable density log (VDL) and SBT across the key zones. Attenuations as high as 15 dB/ft were observed, providing confidence in the cement bond detection.

The results indicated that there was no need for remedial work to improve zonal isolation. The operator was able to proceed with abandonment of the well and avoid expensive grouting procedures.

### Challenges

- Existing light-weight cement slurry with glass beads
- Large 13<sup>5</sup>/<sub>8</sub>-in. casing

### Results

- Accurately identified light-weight cement
- Evaluated reservoir zonal isolation
- Reliable log results helped avoid expensive remedial grouting procedures

Cement Density [F1:CEMDEN]	MD mete		Bel	ow F	ree	Pipe		Shear Attenuation Rate	in listed in	Atte	Shear enuation Rate	1.1.1.1	Gas Liquid Micro- Annulus	Percent Gas	Input Waveform Data	Extracted Formation Waveform Data
0 25 Ib/gal	meters 1:200		Rel	ativo	Bea	1.00		Good Cement 95th Percentile	*	•	dB/ft 360	12	Solid	Liquid Micro	Forst Break (FT:FBREAK)	First Dress. (F1:FBHEAK)
Deviation [F1:DEVIN]		0					60	- Married	Average [F1:SOATAV]	0	20	0	dB/ft 360	annulus	200 1200 Mi Casing First	265 12
0 90	RBVFLAG	R	lativ	e Bo	aring		60	Everies Free Pipe 99th	PI DOAT			-25	25		(F1:FBTT)	Casing First Arrival (F1:FBTT)
Gamma Ray		-		d	-0	-		Percentile		No Cament	221 Best Cement 22115.8 ppg Streny 211 Purbland G, N 15 15.6 ppg Min. 8			Bond Index [F1:Bl]	200 1200 us	[F1:FBTT] 200 120 US
[F1:GR]	[F1:RBVFLAG]	Attenuation	Attenuation	Attenus	Attenus	Attenuation	Attenuation	Average Attenuation [F1:S0ATAV] 0 45	dB.T	ment	Best Cement 15.6 ppg Strength Portland G, Naat	Microannulus	Cement Fluid or Gas	100 0 VDL	Fluid Travel time 200 1200	Fluid Travel time
0 <u>60</u>	SVFL			ation [F1	uation (F1			0 45 stan Minimum			Naat Naat	nulus	Solid	Amplitude [F1:PKWAVE]	WAVE TRACE	200 12 us
TT Minimum F1:S0TTNMN]	Casing	[F1:SOATS]	[F1:S0ATS.1]	[F1:80ATS.2]	[F1:SOATS.3]	[F1:SOATS.4]	[F1:SOATS.6]	Attenuation [F1:S0ATMN]			,			00 00 mV	[F1:WAVE] 200 1200	US Casing First Arrival [F1:PKWAVE] 0
0 90	-7 7	0.6	0 6	08	0.5	08	• *	0 45 #3m						Percent Attenuation	0 16	WAVE TRACE
us TT Maximum	in	7	45/R	1517		4510	dSuit	Masimum Attenuation [F1:50ATMX]						0 100 V		[F1:FORMWAN
F1:S0TTNMX]		Pipe + St	Pipe +	1	Pipe +	Pipe .	Free Pipe + SOSFTH	0 45 etm								
us		SOSFTH	SUSPTI	SASPTI-	SASETT	SACEL	SAGETT	Corrected Attenuation [F1:S0FPAT]								0
		-		8	1	2	}						-	1		
		ľ			5	į	1	3								
		ł	1				ł	\$\$								1.1.1
K		4	í	¢.	ł.		¥.	145	R			P		5	2	200
			ł	1	ł	1	t	10				•		5		一种特
KK			1	Į	1		Í	15				2	-=	TE		
11		\$		1	\$		Ľ.		1	-						1.16.4
5			1	8	1	L	1	100								i 1
			5	2			Ļ	13		-	- 16		1	5		A. (
		1	\$	1				1				2		1-		
150			1	1	Į			<u>k</u> —					_ 5			
		2		1	1		Ň.	1		-			-	(Indiri:		
R		2	2	1	8		1	KA-	-		-			<b>}</b>		
K		Ţ	1	Ş	ļ	ľ	Ţ	13				i.		1		
1		2	1		1		1							{		
リリ婆		1		1	1		5	13				_		1		
		\$	2	ţ	2	ľ	1									3
1 Ste		H	1	\$		ŝ	1	135					2			
		4	2			ł	K		R	1	£.,					1 104
		1		1	ł	3	1				-			1		1114
		5	}	5	8		,	1			-		-			目前的
			3		1		2	N								一個的
i B&		Í	\$			Ì	1	13			-					
		t	5		X		+	15			3.		1			1 615
		4		3	1		1	1		-	-7-		¥-,			
		1	1	2	1	Ì	Î	1								1 1 1 1
		}		+	-		+	-								
				8	2		2					2				1.000
							1	No.	1	-		É	- Man	and the second se		
						¥.		-						Î		
		1			1	X		12				2				1128
		-	-	-	l	2	1	<u></u>		-		2	- 8-			1.1.192
		3	0.1		4	Į.	ļ.	<u></u>			-		-			
			2	8	1	ľ.		No.					1			1.1199
			A			~~~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	1	A stranged and a large started			-	-	P	>		
DI TC		18-		IV I	19	N	1	18	1. 5				1 miles			1 1118

INTeX log showing a good cement bond over the pertinent reservoirs

