

Managing Drilling Hazards: Geo-Drilling Events Database

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- Database in a nutshell
- Tool Demo (Aalderik Baud)
- Questions

Background

Why are we doing this?

- Improving well safety and well cost related to Geological Drilling hazards: reducing NPT
- Providing a better <u>understanding</u> of geological drilling hazards in NL
- Learning from past geological incidents encountered by all operators by <u>sharing information</u>
- Using offset well data efficiently to optimize well design

GDE DB* Project background

2013 2015 2017

Phase 1: Feasibility

- TNO JIP: pilot to investigate feasibility geo-hazards database
- ~100 wells analyzed
- 11 operators participated
- Feasibility proven: EBN decided to take lead for follow-up

Phase 2: Development

- EBN reviewed pilot data
- Defined GDE DB structure
- Analyses by experienced Well Engineers
- Presented to NOGEPA and received full support

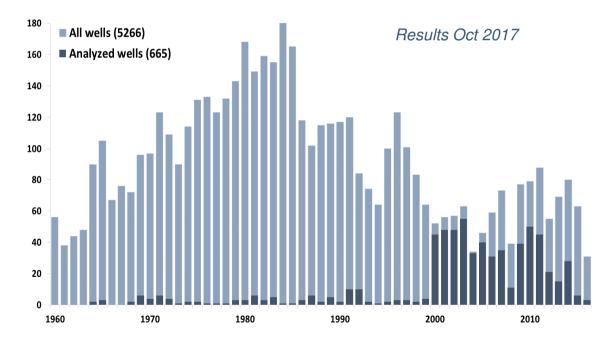
Phase 3: Deployment

- EBN tested operational GDE DB Tool (650+ wells analyzed)
- Roll out to Partners in August 2017

*: <u>Geo Drilling Events DataBase</u>

Resources & Results

- Building on 2013 JIP learnings (NOGEPA, EBN, TNO)
- Analyzed by Experienced Well Engineers
- Public data NLOG (well reports, DDRs, etc.)
- EBN data (for wells <5 yrs)
- Data available via EBN hosted Spotfire project (secure environment)

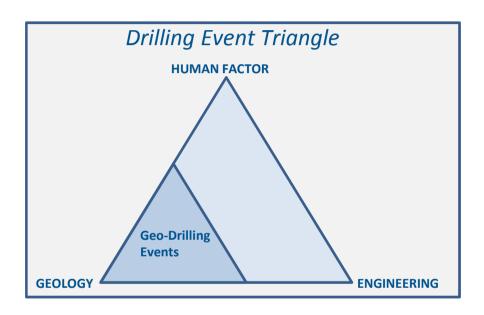


Geo-Drilling Events Database

	Well Materials from I				1			la	_															
Wall Data	Mail Matodata took	NI OS TNO		_	_	•	T	Gardenical Incident		•		1					Incident END	Incident END	·	Stratigraphic unit	Manuel deviation	Geological Marant		Balareace
	Operator	Licence Name/Numbe	er Well category	Year of soud	Well trajectory	Surface coordinates (UTM31-EDSE)	Surface coordinates (UTM31-ED50)		dent Code	Cassification	Short description	Narrative Summary	Incident START	Incident END-date	Incident START	Incident START	death if	depth if	Strattgraphic unit	of Incident - DND	between Incident	o T	Geological Hazard	ation
						(UTM31-ED50)	(UTM31-ED50)						date	Fappropriate	depth	depth	appropriate	appropriate	of Incident - START	(Fdifferent from start)	START-END depths			
10		•	¥ 6/4/0 ¥		very/dey/hors				CODE	L/M/H	1 line only		dd/nm/yyy	dd/mm/yyyy ×	mAHRT Y	mTVGSS ×	mAHRT	mTVOSS *	STRAT_UNIT_C	STRAT_UNIT_C	Degrees 🗷	1 2	nersative summary	currents I
P11-A-0	Canada (Dona	ME/EP/UM4030364	D	2006	deviated	5801250	523290	\square	2			Gumbo balling, poor penetration, packing aff. Known hazard in N.Sea Group	14/08/06	15/05/06	596	575	611	593	NJ		27	7 3	hales react with WBM	See Tab
	eun)										suffer this problem. Well TD is 200m shallow, tanset reservoir exposure reached.					1			1			_ ~	'	Reference and extract from mud summary
P21-07	Persieum	ME/EP/UM4333364	£	2001	_	+	+	+-	_	_	Well ID 8 John sharow, target reservoir exposure reached		_		_	_		_				-		_
P30-03	Oil (Dana	E/E0G/MW/9808689	4 E	2001							Huge delay in moving the rig and starting due to weather. Otherwise													
P11-C-01	Petroleum) Dana Petroleum	ME/EP/UM4323364	-	2011						_	ne incidents TE-LATERAL WELL					_			_					
P11-0-01	uana Peroleum	WCENOMEROR		Aut				, ×			Failure of MSPC stage cementing equipment. Several remedial													
											squeeze jobs required. No geological based incidents.													
F02-A-03	Veba Oil (Dona Petroleum)	382/11/985/EMK	D	2001				N			Cemented in running string of 7"liner. Flash set cement. Back off required, 12.75" section redrifted. Not geological related, cement					1			1					
	resoleum										required, 12.25' section redrines. Not geological related, cement quality													
F06-03	Petro-Canada (Dana	ME/EP/UM/00046774	E	2004				N			Chalk prospect well. No excessive geopressures encountered as in													
911.04	Petroleum)	E/TAM/RODGADSA	-					N .		_	F02. Extra casing string set to cater for possible geopressures. Several unplanned cores were taken. Oil discovery		_			_			_					
P11-06	Amoco	UUMYSSIGNIS	-	1997	devlated	5834067.2	551706.4	N N	4	_	several unplanned cores were taken. Oil discovery salt water kick in the Zechstein	salt water icis in the Jachstein	30/38/99	14/10/99	3862	_	4233	_	2054	_		6	salt water it is	Brilling reports, geological report
Christian .	004 Ave			2005	risisisted	5334502.2	5517al.4		16		shandoned haracse of problems during the \$" liner rementation.	shardonal harassa of problems during the C liner remembation	non-service deliny						IMPE			- 1		Brilling reports, gardinglesi report
G16a-82	GDF Suez	G16a	D	2011	deviated	5999364.9	647989.2	N	15	1	motor fallure	motor failure - At 2746 m. Allmost no penetration rate was noticed and we were not able to stall the motor, with 22 tan on the bit there was just 50 psi differential pressure therefore decision was made to pull out of	26/03/07	29/97/07	2746		1		KWGL	1		2	stuck point	Drilling reports, geslogical report
	1		1		1	1				1	1	with 25 tan on the bit there was just 50 ps differential pressure therefore decision was made to pull out of hole and change motor, bit and hydrastab.			l		1			1	1 1			
SIENAS	COL Super	6160	n	2011	deviated	5999363	647951	¥	33		few washouts, poor fleal Time Git readings	few washouts in chill string (8 bit depth: 2278m, 2334m, 3029m, 3453m and 2692m	19/05/12	22/01/12	2276		2692		α	XXX		W		Brilling reports, geological report
G16a-84	GOF Suer	G16a	D	2012	deviated	5999363	647991	Y	20		a few washouts in drill string @ bit depth: 2278m, 2334m, 3029m, 2452m and 2692m, poor Real Time GR readings in	poor Real Time GR readings in interval 2885m to 3221m MD - what determined to re-log-hole in same intervals.	26/05/12	27/01/12	2885		3221		KNSL	M150		w		Brilling reports, geological report
											internal 2885 m to 3221m	Property.				1			1					
											MD - what determined to re-log hole in some intervals.													
F3-8009	GOF Suez	F3	D	2011	deviated	6279979.6	608955.07	Y	4		drill string stuck.	Figh gas readings and well flowing was observed at 3858 m. Well was shut in and	29/05/12		3734				SLCU			6		Brilling reports, geological report
					devlated	6279979.6	60895.07		1			pressures monitored. Mud weight increased from 1.08 to 1.27 sg. Drilling couldn't be resumed because of drill string stuck. Worked and jamed to free it and reduce MW to	34/03/12		3859				SCV			D		Drilling reports, geological report
												1.05 sg. After a few days of unsuccessful attempts, it was shot off and remained 104 m of BAA downhole.												
K12-5571	Placid	112	D	1981	deviated	5814080.4	541075.7	Y	3		drillpipe became stuck (differential sticking) It was impossible to work the algeline free and it was decided to	Unexpected lamprophyre section the Basal Zechstein was found close to the expected depth.	30/08/81	04/50/85	3030		3288		ZESA				Unexpected lamprophyre	Drilling reports, geological report
											shandon the well.					1			1				90001	
					deviated	5934090.4	\$43025.2		1			Unexpected lamprophyre section the Basal Zechstein was found close to the expected depth.	30/08/91	04/00/80	3030		3288		2058			A	Unexpected lamprophyre	Onling reports, geological report
					deviated	5814080.4	54005.7		1			In total SEE for this misture was chilled before the drillaine became stuck idifferential sticking it was				1			ROOT				section	
					deviated	5834080.4	5410/57		1			In total 361 R of the mature was critical before the drillipge became stuck (differential sticking) R was Impossible to work the pipeline free and it was decided to abandon the well.							HDCL1					brilling reports, geslogical report
E17a-64	GOF Suec	£17	D	2012	deviated	5994705.2	529651.9	4	1		mud motor stalled and lost after drilling to 4270mMO	Mud motor stalled and lost after drilling to 4270mMD. Several unsuccedful attempts to free the drill string	62/04/12	12/04/12	4270				RDCL			F	goor hole stability because of abundent natural fractures	Final Geological report (June 2002)
		_			deviated	5830703.7	623000.8	_		_	the string became stuck.	ended with setting a coment lick off plug between 4360m to 3070m and drilling a side track from 4330m. Due to already high tarque during drilling caused by cutting build up, which increased when drilling in the	61,03/50	12/03/20	1600		2000	_					poor hole stability due to problems in the Tertiary	final well report
L156-A005	GOF Suez	L15b	D	2000	cewated	3030/03.7		4	1		the string declarie state.	chalk to set the 13 3/8" casing shoe, the string became stuck.		12/03/30	l .		2000					ž.	good not stating that is provided in the Lettary	ins we root
HARM	Marid	110	0	1085	devlated	5828303.4	584285.4	Y			collapsed casing	collapsed coing due to sait flow re-entry	18/03/96		3006				2534			5	salt flow re-entry	Formation evaluation data
V13,68	ISM Stee	177	n	3002	deviated	5812451.8 5812451.8	565470.5 565470.5		1	1	Low drilling rate in the Zechstein, stuck pipe	30 days due to the occurrence of almost 200 m of high strength (greous (lamprophyric) rock in the Zechstein Stuck place in 3777 m. in 3778	28/05/07		3768 3777		3778		205A 205A	1	1 1		Improphys section socialisms and the section social section se	Brilling reports, geological report Brilling reports, geological report
WIT-1	NAM	Drenthe	E	1994	vetical	5875248	727579	Y	7		Soft formation, unable to achieve KO	Soft formation, unable to achieve RO	20/11/94	21/11/94	668		668		NJ	MU		2		
WIT-1	NAM NAM	Drenthe Drenthe	1	1	vetical vetical	5875348	737579	1 1	3	1	Abrasive fm. drilling too deep, section TD missed	Abrasive formation Drilling too deep, section TD missed	30/11/94 64/12/94	06/13/94 06/13/94	2130 2498	1	2130 2498	1	RNS08 20201	8854R 20204	1			
WIT-1	NAM	Drenthe Drenthe	1		vetical	5875248 5875348	797579	N 2		1	drilling too deep, section TD missed While RIH 13 3/8" cone stuck in OKSR	Drilling too deep, section TD missed While RW 13 3/9" care stuck in CKGR	06/13/94	09/33/94	2498 2387		288		20391	CKGR	1 1	5		
M00-2	NAM	Ardel II	E	1586	vertical	534367	625291	Y	1		directional problems and plugged nocoles	Directional problems, plugged reacies (32.25 hole)	1	7					Al	AT	- 7	š		
MOL-2 MOL-2	NAM NAM	Andel II Andel II	1		vetical vetical	5342662	625291	1 1	1	1	heavy reaming Hole problems, stuck pipe	Heavy reaming (12.25 hole) After havy reaming the drill stringstring became stuck > sidetrack (12.25 hole)	62/03/96	12/03/96	2290		2230		AT	AT	3	5		
MOL-2 MOL-2	NAM	Andel II	1		vetical	534060	625291	1 ;	1	1	nore procrems, stuck pipe Slow procress	when havy reaming the brill stringstring became stuck > sidetrack (12.25 hale). Slow propriets.	1008/86	12/43/96	2290		2230		AT.	AT	1 1	5		
M06-2	NAM	Andel II															2713					\$		
MOU-2 MOU-2	NAM	Andel II	1													1	1	1	AT	8007	1	5		1
55M-4	NAM	Groningen	·	1-1		L	-								-	_	1226	-	CKGR	CKGR	\vdash	- A		
EW2-3	NAM	Groningen	J L	เลา		LVD	es										1300		NUFFY	MISSE		š		
COV-58	NAM	Groningen Schoonebeek				- 7 P		•							- F	_	3889	\vdash	2023H	2023H 2023H	\vdash	6		
AME-205	NAM	TER														_	1349		MARY	NAPE	-	5		
AME-205	NAM	TER														1	1979	1	CKGR	CKGR	1	À		1
AME-205 BRAK-01	NAM	TER .	4								_				- 1	-	2323		2534	ZESA	\vdash	- 6		
BRAK-01	NAM NAM	Andel-III Andel-III	1			<u> </u>	~ ~:	~		Ⅱ ~	lata					325	438 438	418	NUOT NUOT	1	1 1	w	Swelling days or wishouts, may be potentially caused by washouts Swelling days or wishouts, may be potentially caused by washouts	1992-07-02 BRAN 1 Description of operations 11-05 to 02-07-pdf 1992-07-02 BRAN 1 Description of operations 11-05 to 02-07-pdf
					רו	PΠ		(\N	10	H ()	ומומ													
					\sim	\sim \sim \sim	\sim 1 $^{\circ}$	~ "	_		144				- 1									

- 2. Geo-Drilling Events (facts)
- 3. Geo-Drilling Hazards (interpretations)
- 4. Reference

What Drilling Events are captured?



Drilling Events can have one -or more-causes!

- Geo-Drilling Events have a significant geological component in the cause.
- ,, require geoscientists for understanding.
- ,, can often be avoided by doing geological homework.

Results To Date*

Number of wells analyzed

Number of boreholes analyzed

- Wells with Geo-Events
- Number of Geo-Events
- Wells with Insufficient data

Wells

Wells

without

Geoincident

57%

Wells

without

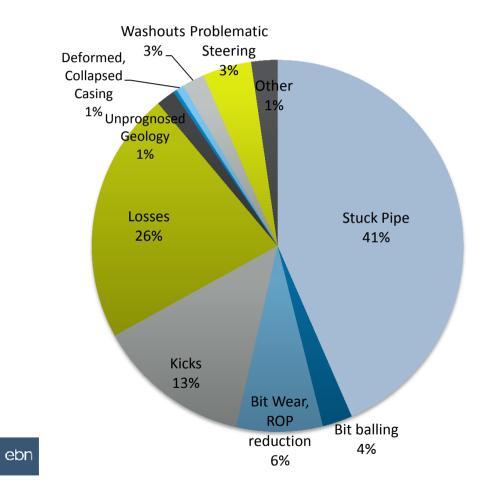
Geoincident

43%

*statistics as per nov 2017

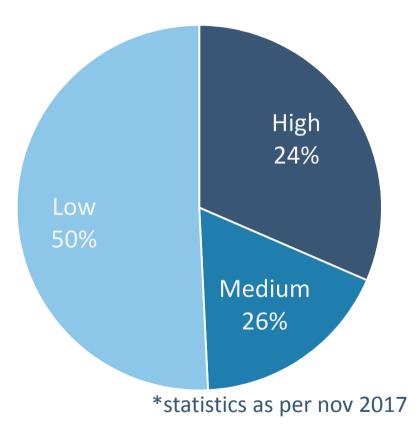
Geo-Drilling Events

1	Stuck pipe (incl Overpull, Torque)	272
2	Bit balling	27
3	Bit Wear, ROP reduction	39
4	Kicks	87
5	Losses	172
6	Unexpected Geology	8
7	HC (unexpected)	2
8	H2S (unexpected)	5
9	Deformed, Collapsed Casing	6
10	Washouts	17
11	Problematic Steering	20
12	Other	8
12	Other	0



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Geo-Drilling Events: severity*



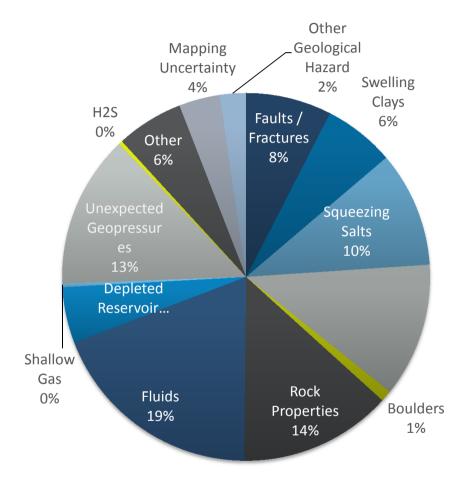
Severity of incident:
Semi-quantitative classification
based on NPT and (potential) impact.

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Geo-Drilling Hazards

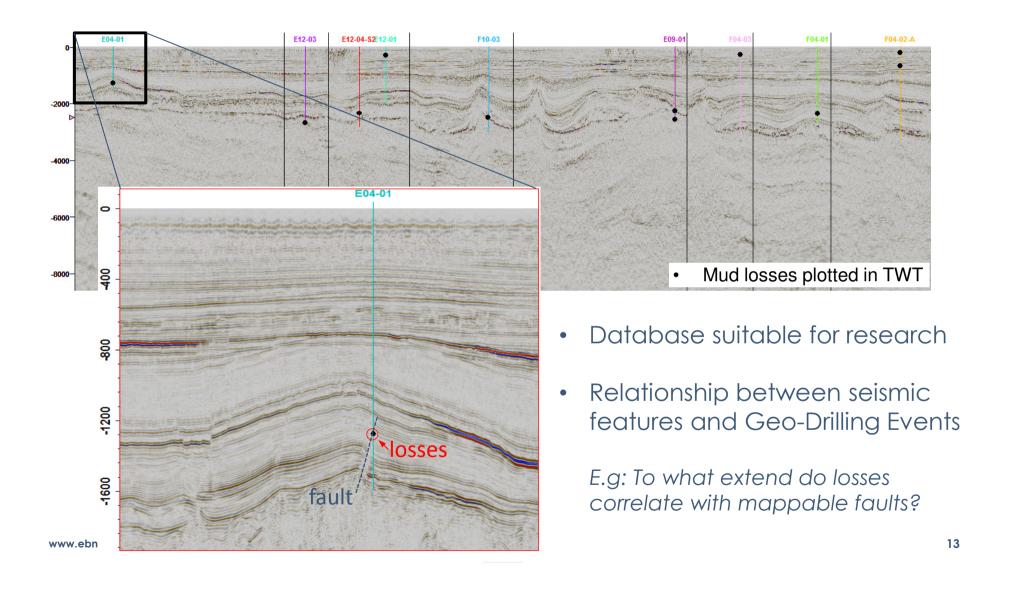
	Rocks	462
F	Faults / Fractures	55
С	Swelling Clays	153
S	Squeezing Salts	75
W	Weak Formations	102
В	Boulders	4
R	Rock Properties	73
	Fluids	110
D	Depleted Reservoir	18
Ε	Shallow Gas	4
G	Unexpected Geopressures	84
Н	H2S	4
	Other	91
M	Mapping Uncertainty	15
	0.1 0 1 1 111	
Z	Other Geological Hazard	76

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Demo GDE DB Tool





GDE DB Tool access: www.ebn.nl/partners

Questions?

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