Coal Ash behavior in a Power Plant

GTT – 15th Annual Users‘ Meeting, Herzogenrath, 03-05/07/2013

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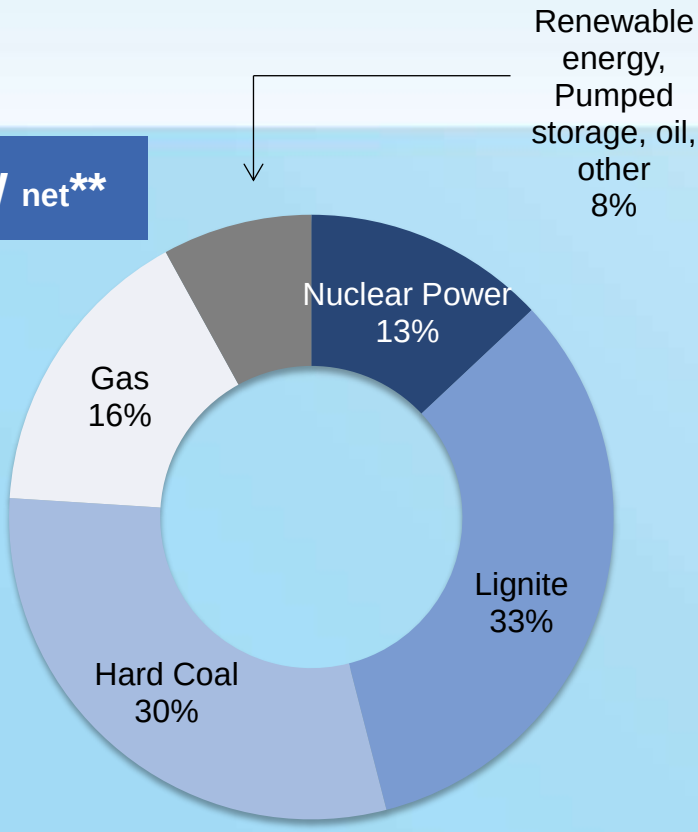
Power-plant capacity of RWE
Power by primary energy source*

30,082 GW net**



* for fiscal year 2011
** including capacities of power stations not owned by RWE that RWE may deploy at its discretion on the basis of long-term agreements.

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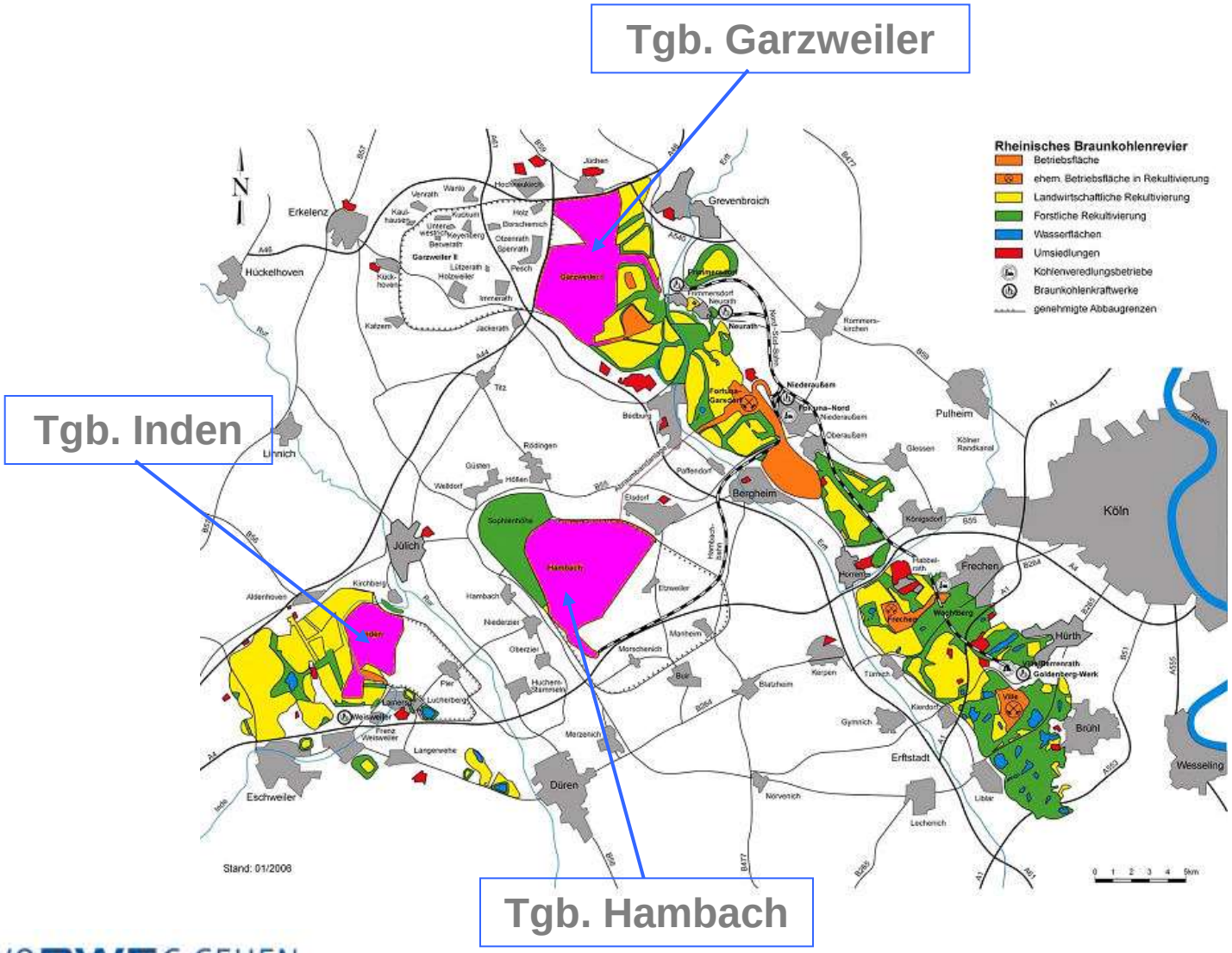
Lignite in the Rhineland

Mining, power generation, upgrading

Rhenish Lignite Mining Area.



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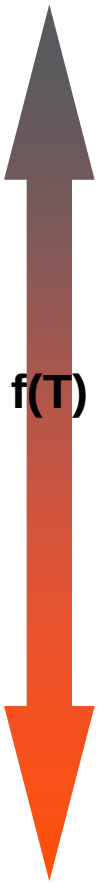
Opencast Mine Inden and Power Plant Weisweiler

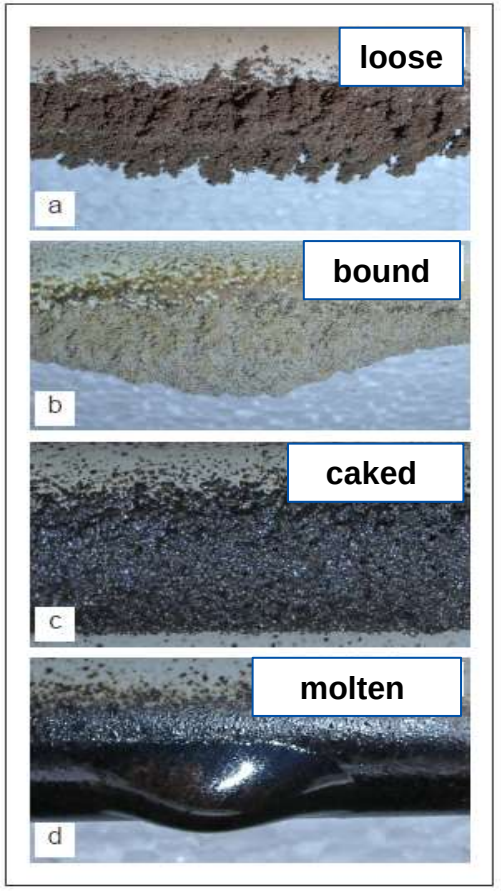
Forms of slagging and fouling

Fouling

Sintering

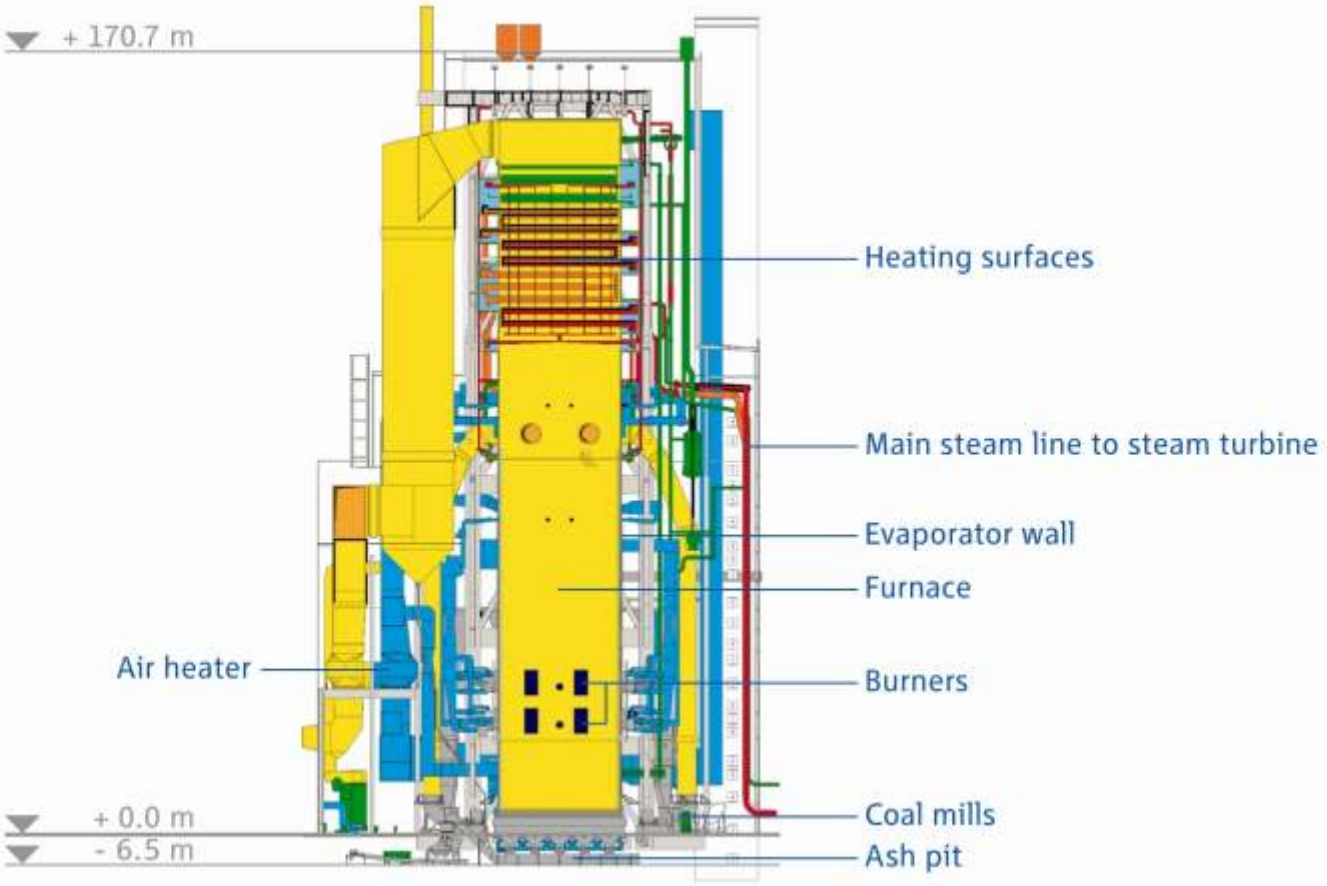
Slagging





Slagging must be technically manageable or preventable

Power Plant Weisweiler



Slagging in Furnace and at Burner level

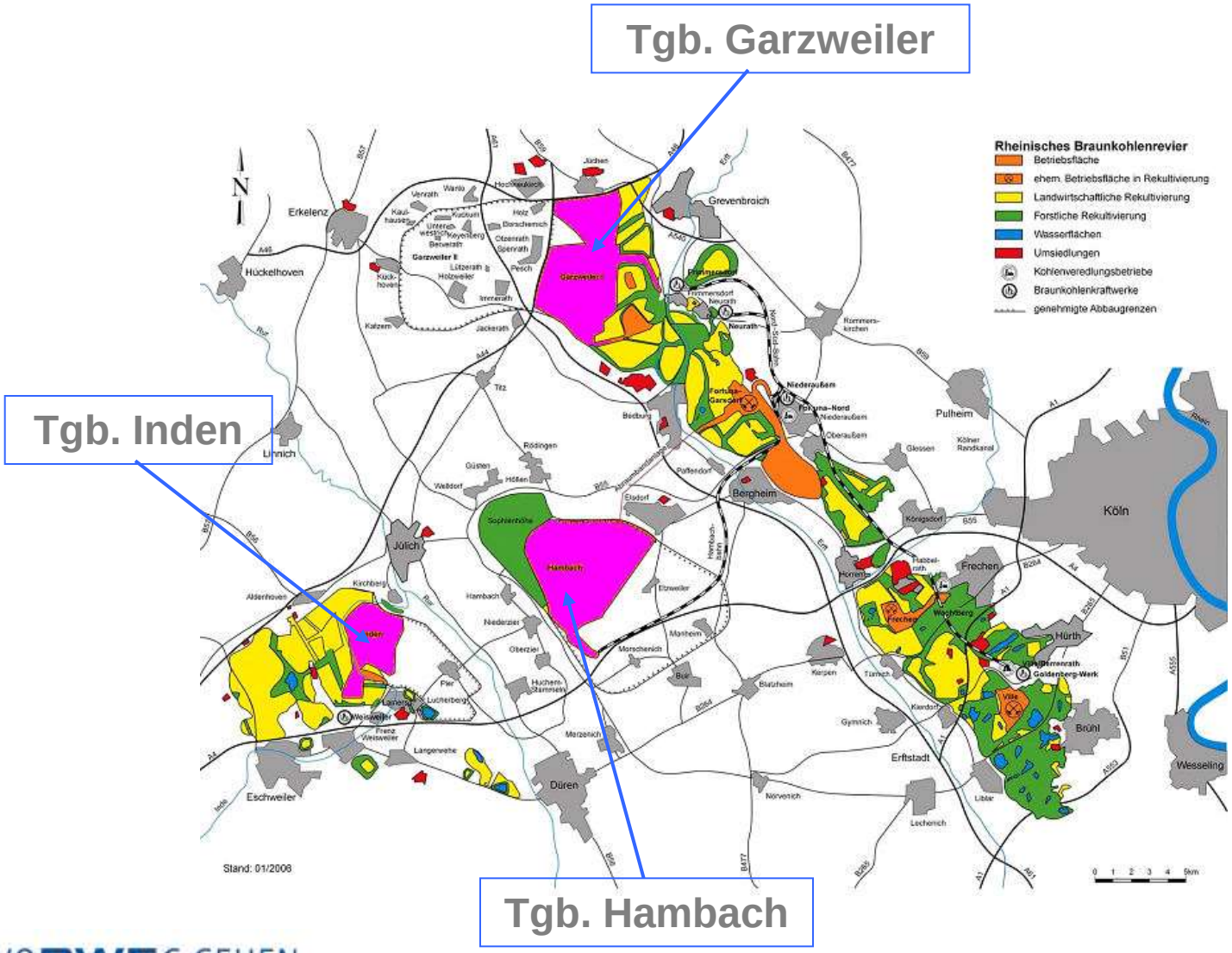
Lignite

Kohlearten				Wasser-gehalt (%)	Energie-gehalt af* (kJ/kg)	flüchtige Anteile waf** (%)
UN-ECE	USA (ASTM)	Deutschland (DIN)				
Peat	Peat	Torf				
Ortho-Lignite	Lignite	WEICHBRAUNKOHLE		75	6,700	
Meta-Lignite	Sub-bituminous Coal	Mattbraunkohle		35	16,500	
Subbitum. Coal		Glanzbraunkohle		25	19,000	
Bituminous Coal	High Volatile Bituminous Coal	Flammkohle	Steinkohle	10	25,000	45
		Gasflammkohle				40
	Medium Vol. Bitumin. Coal	Gaskohle		Kokskohle 36,000		35
		Fettkohle				28
	Low Vol. Bitumin. Coal	Eßkohle				19
Anthracite	Semi-Anthracite	Magerkohle				14
	Anthracite	Anthrazit	HARTKOHLE	3	36,000	10

af* = aschefrei waf** = wasser- und aschefreie Substanz

	Deposit
Origin	in the Tertiary period (12 – 20 mill. years ago) from subtropical vegetation
Volume	55 bn t in the Rhineland
Stripping ratio	4.7 : 1
	Quality
NCV	Ø 8,700 kJoules (= 1/3 tce)
Moisture	50 - 60 %
Ash	1.5 – 8.0 %
Sulphur	0.15 – 0.5 %
Calcium and magnesium	bind gaseous sulphur dioxide in the ash

Rhenish Lignite Mining Area.



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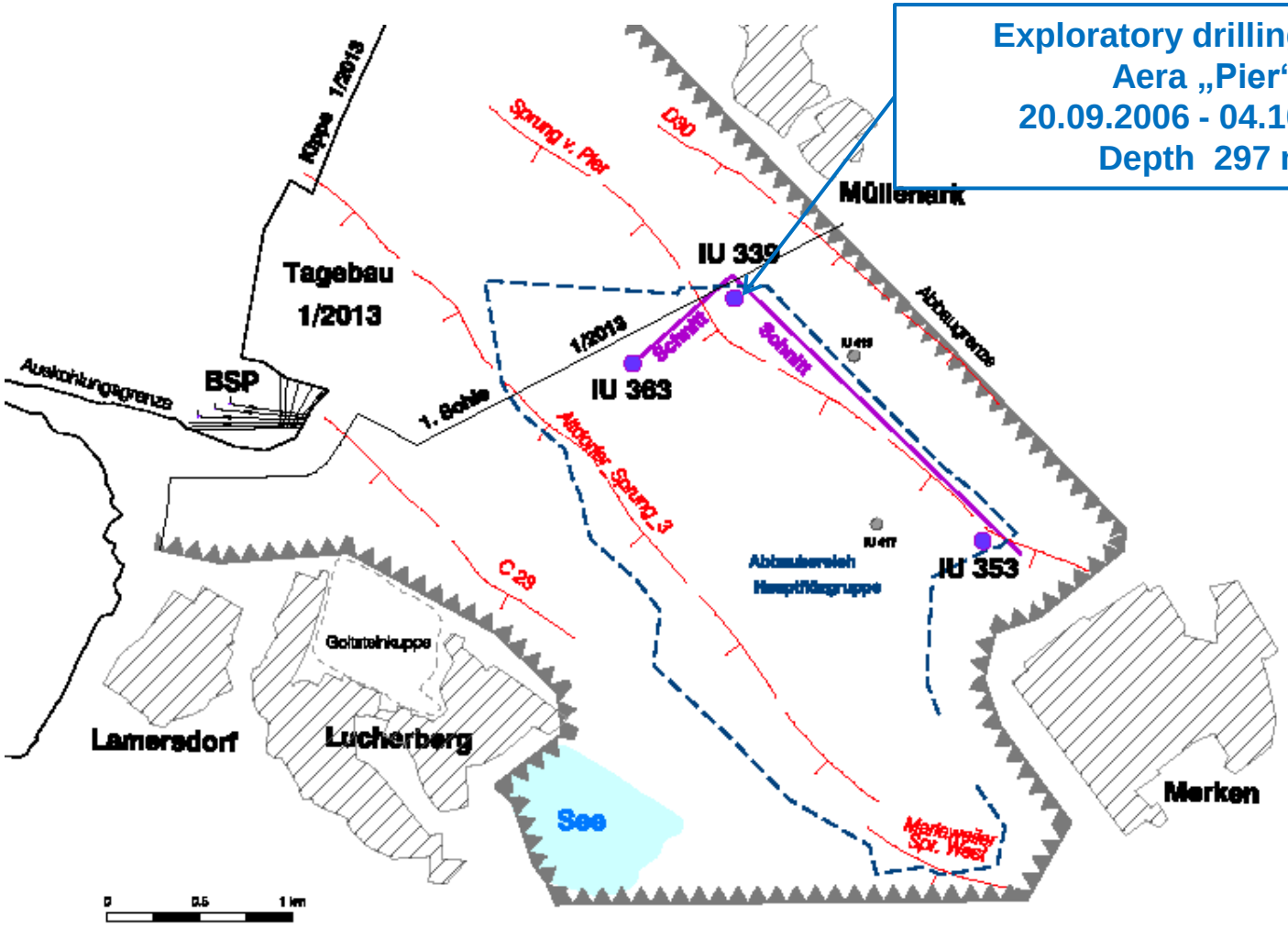
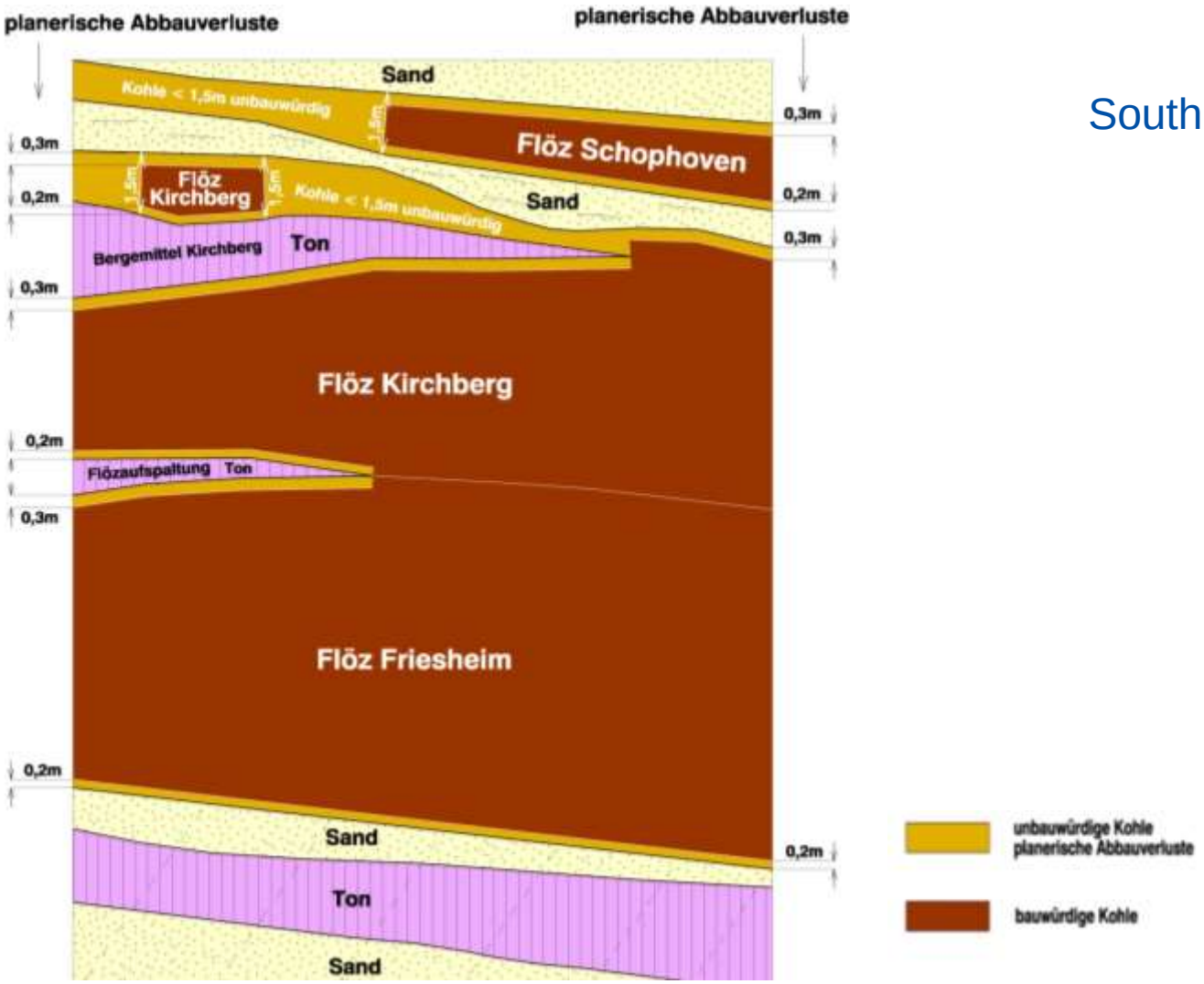
Location of the exploratory drilling



Open Cast Mine Inden: sub-surface coal seam

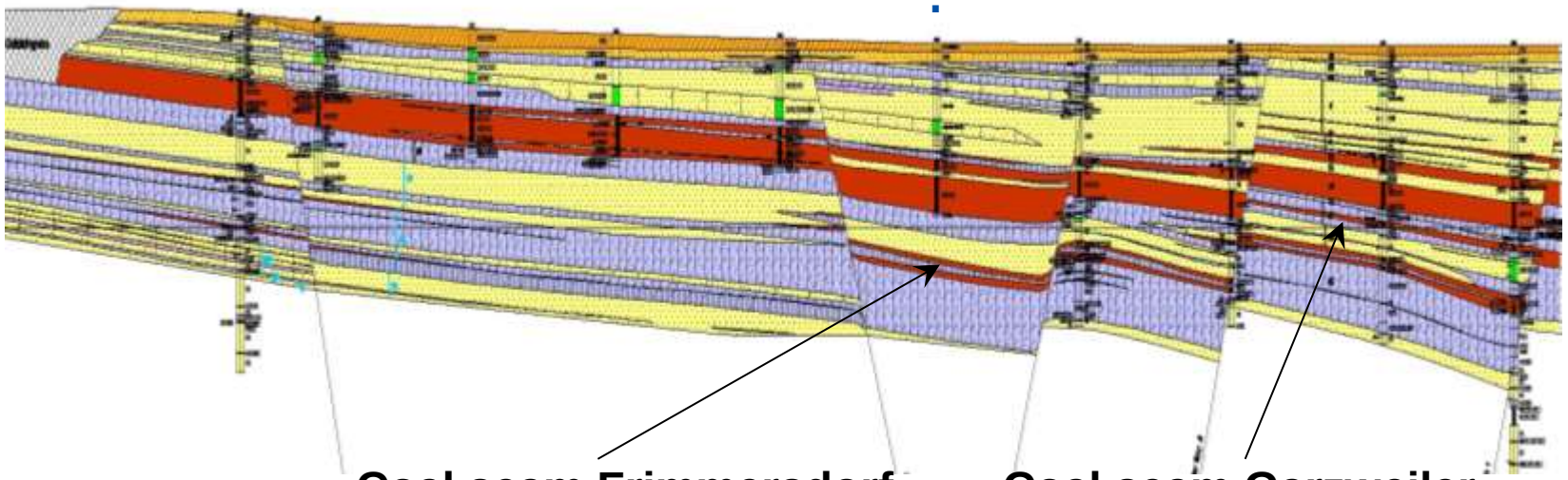
North

South



Open Cast Mine Inden

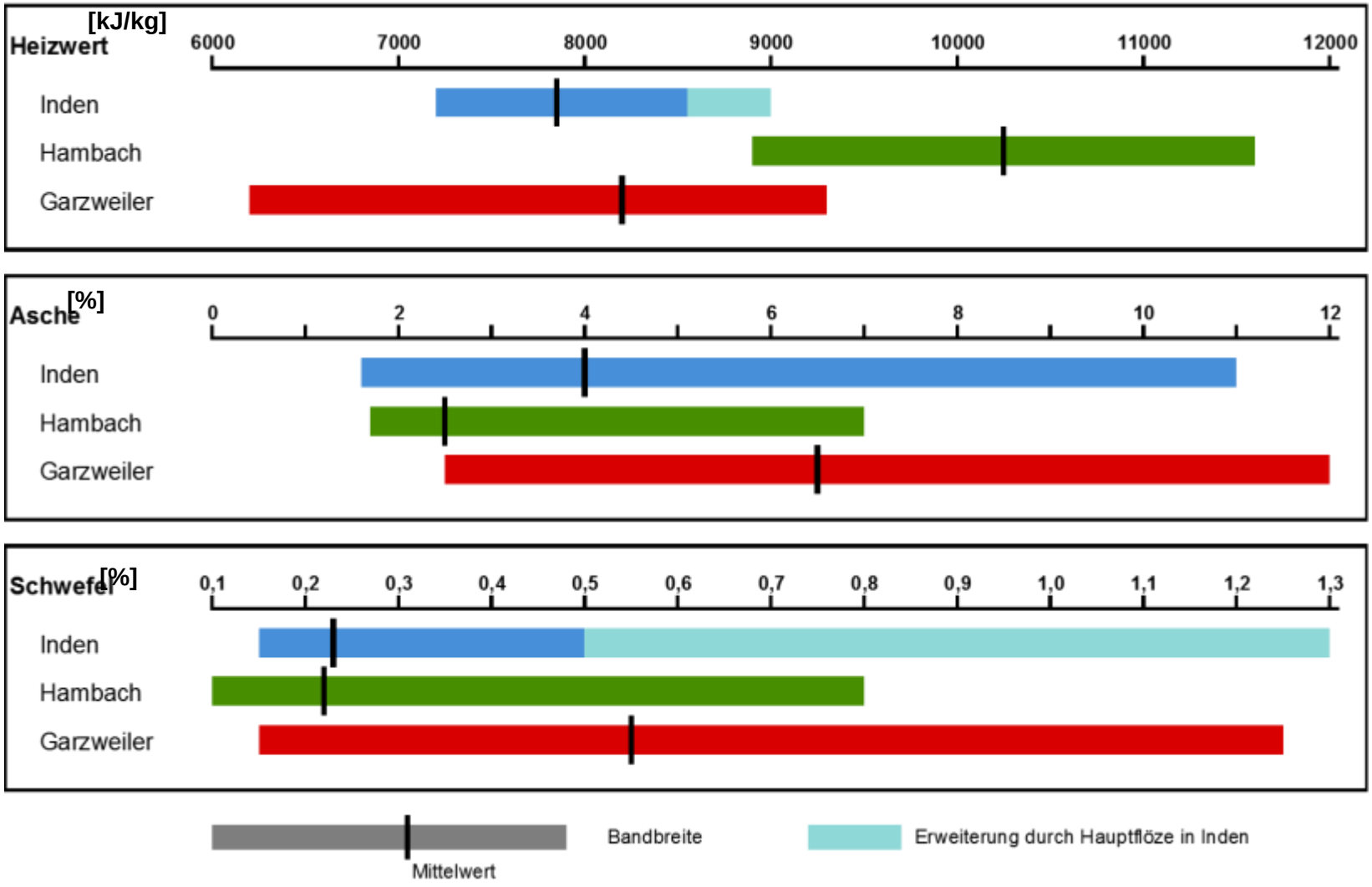
Outlook: **From 2017 sub surface seams and ash-rich and water-poor seams Garzweiler and Frimmersdorf are mined**



West Aachen

East Cologne

Comparison of coal quality parameters of the mines



Temperature-dependent concentration of melt phase.

>Thermochemical calculations using FactSage

Criteria for assessment of slagging

> Element oxide composition (XRF)

> Mineral phases composition (XRD)

> Ash melting behavior (D{eform.}T, H{emisph.}T, Flow T)

> **Amount of liquid phase (partial melt) and solid phase**

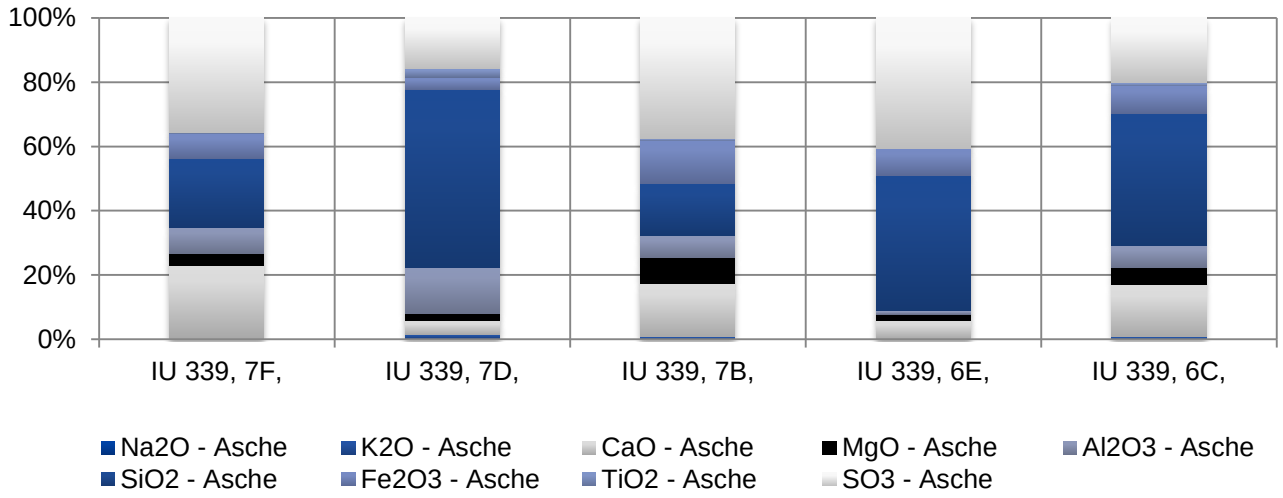
> Composition of liquid phase

> Melt viscosity

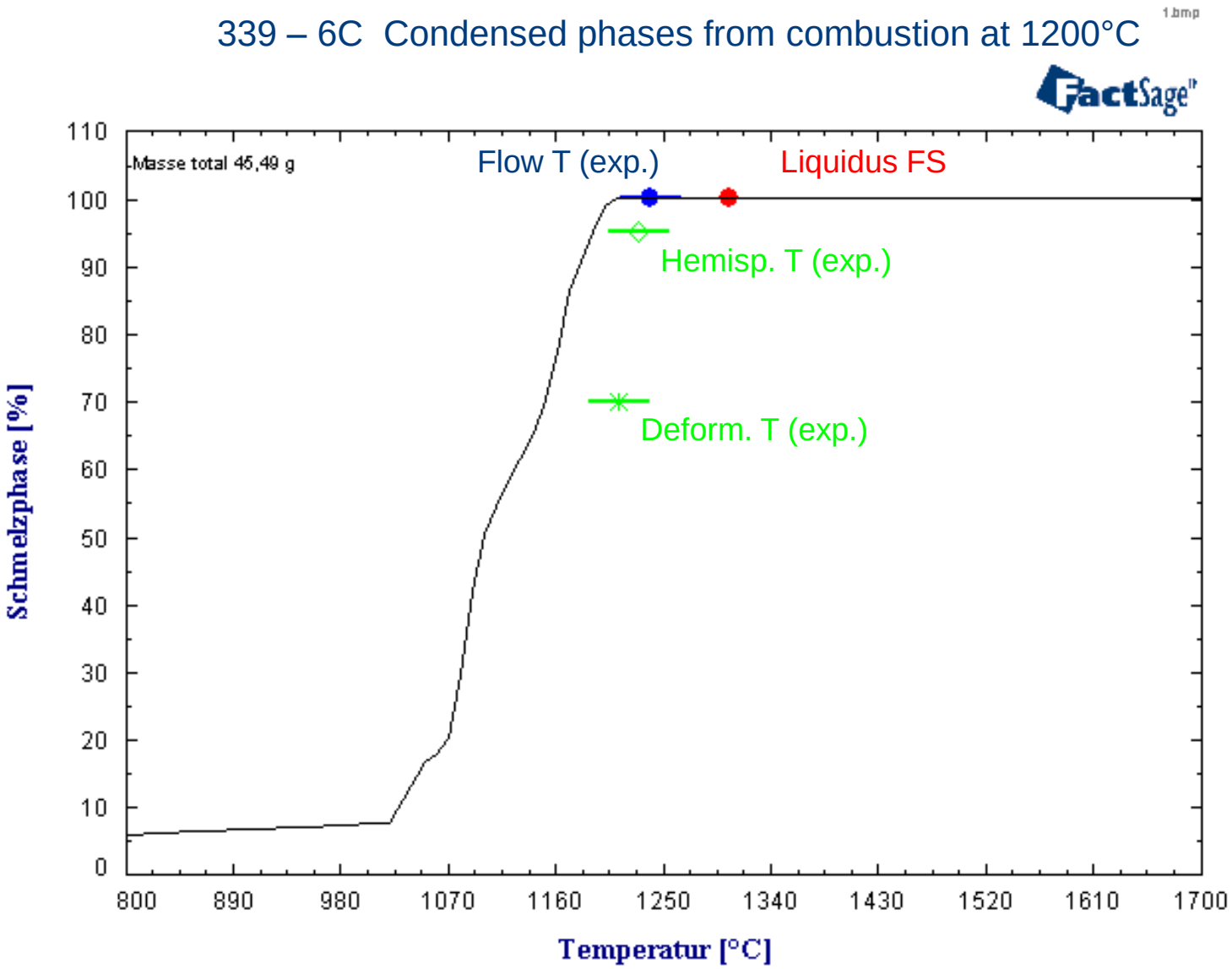
> Surface tension

Element values of the coal

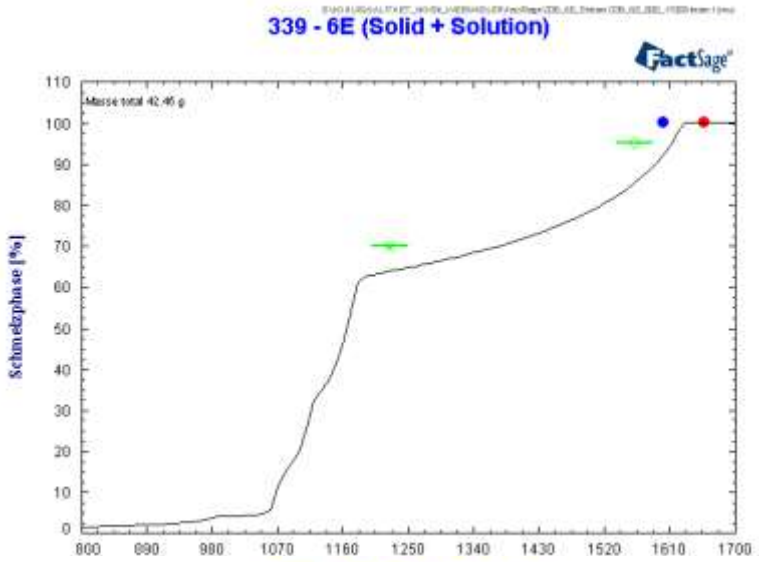
Probenbezeichnung	Wassergehalt	Aschegehalt bei 815°C	Brennbare Substanz	Schwefel	Heizwert	Na2O - Asche	K2O - Asche	CaO - Asche	MgO - Asche	Al2O3 - Asche	SiO2 - Asche	Fe2O3 - Asche	TiO2 - Asche	SO3 - Asche
	Gew-%	Gew-%	Gew-%	Gew-%	kJ/kg	Gew-%	Gew-%	Gew-%	Gew-%	Gew-%	Gew-%	Gew-%	Gew-%	Gew-%
IU 339, 7F,	56,5	2,89	40,61	0,23	8534	0,16	0,08	12,57	2,19	4,52	11,96	4,39	0,20	19,87
IU 339, 7D,	54,7	7,89	37,41	0,26	7724	0,19	0,62	2,21	1,12	7,47	28,94	2,08	1,39	8,23
IU 339, 7B,	56,2	2,33	41,47	0,19	8607	0,21	0,21	9,10	4,30	3,78	8,76	7,27	0,44	20,36
IU 339, 6E,	53,8	8,73	37,47	1,01	7531	0,13	0,07	3,96	1,49	0,74	29,94	6,05	0,15	28,89
IU 339, 6C,	50,6	6,06	43,34	0,28	9330	0,17	0,29	9,22	3,04	4,04	23,41	4,92	0,53	11,54

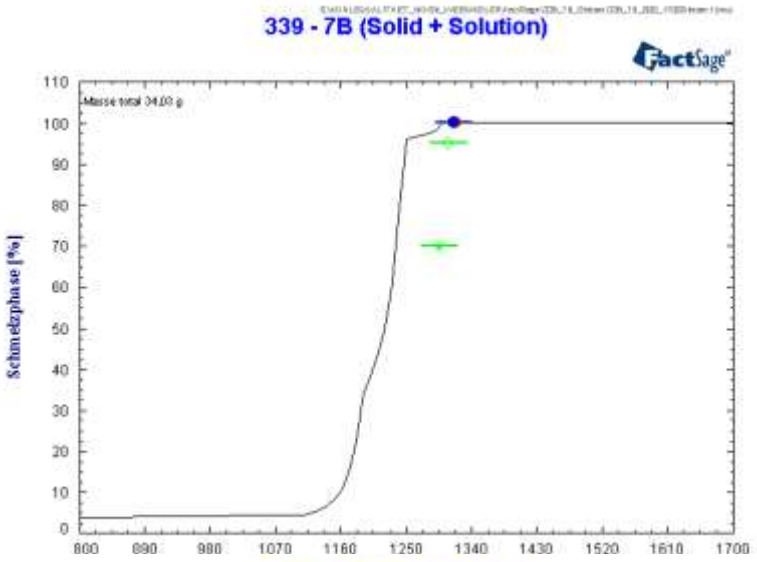


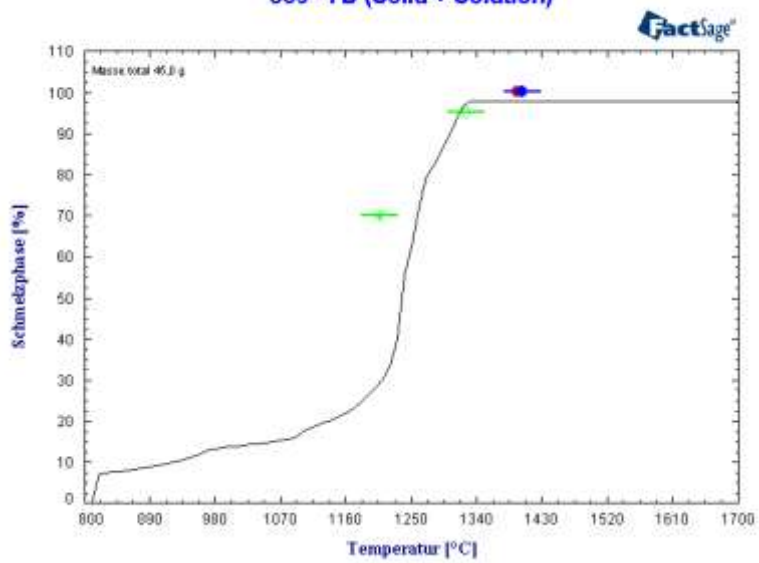
Melting behaviour of the coal 339 - 6c

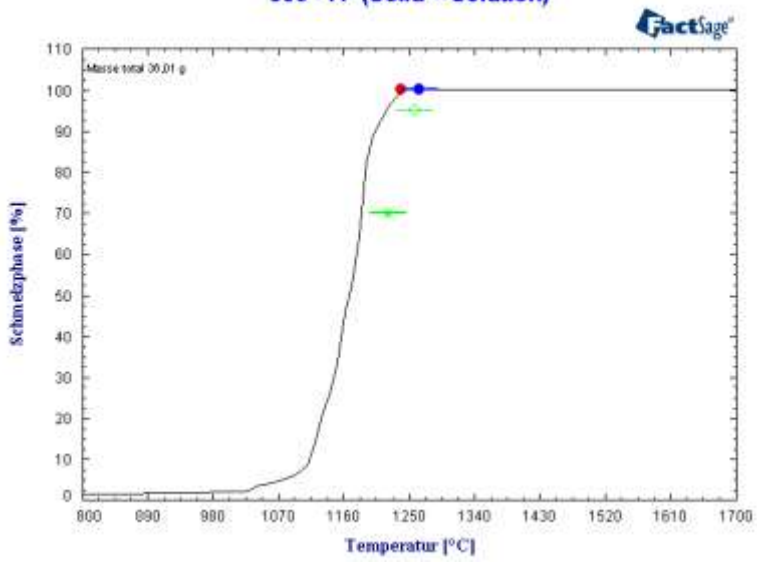


Melting behaviour of other coals









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Conclusions

> Real world coal combustion is a very complex process since the composition of the coal itself as well as that of the ashes can vary considerably.

> Thermochemical calculations accompanied by test experiments can give guidelines to the process engineers to understand the characteristics of different coals.

> In future thermochemical calculations can be used to prepare for coal blending which will help to smoothen the operation conditions even if the coals are very divers.

Thank you for your attention !

> **PLEASE GET READY FOR THE EXCURSION !!!**
> **FIND YOUR DRIVER NOW !!!!**