Coals Industrial Beneficiation Processes from Santa Catarina, Brazil: Inorganic Components Geochemical

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4th INTERNATIONAL WORKSHOP
ADVANCES IN CLEANER PRODUCTION

"CLEANER PRODUCTION TOWARDS A SUSTAINABLE TRANSITION"

•Brazil's total coal resources are in the order of 32×10^9 tonnes, the majority of which (89%) are located in Rio Grande do Sul. Most of the remainder (a little over 10%) are located in the adjoining state of Santa Catarina. In Santa Catarina the most of the seams mined have marginal coking properties, but current production is almost entirely used for electricity generation at the Jorge Lacerda (Tractebel Suez) Power Station (875 MW), located near Tubarão city in the NE of the state.

COAL BACKGROUND

Peat forms from the accumulation of partially decomposed plant materials under generally wet conditions having a restricted supply of oxygen. Coal is formed from the compression and alteration of partly decomposed peat.

Location

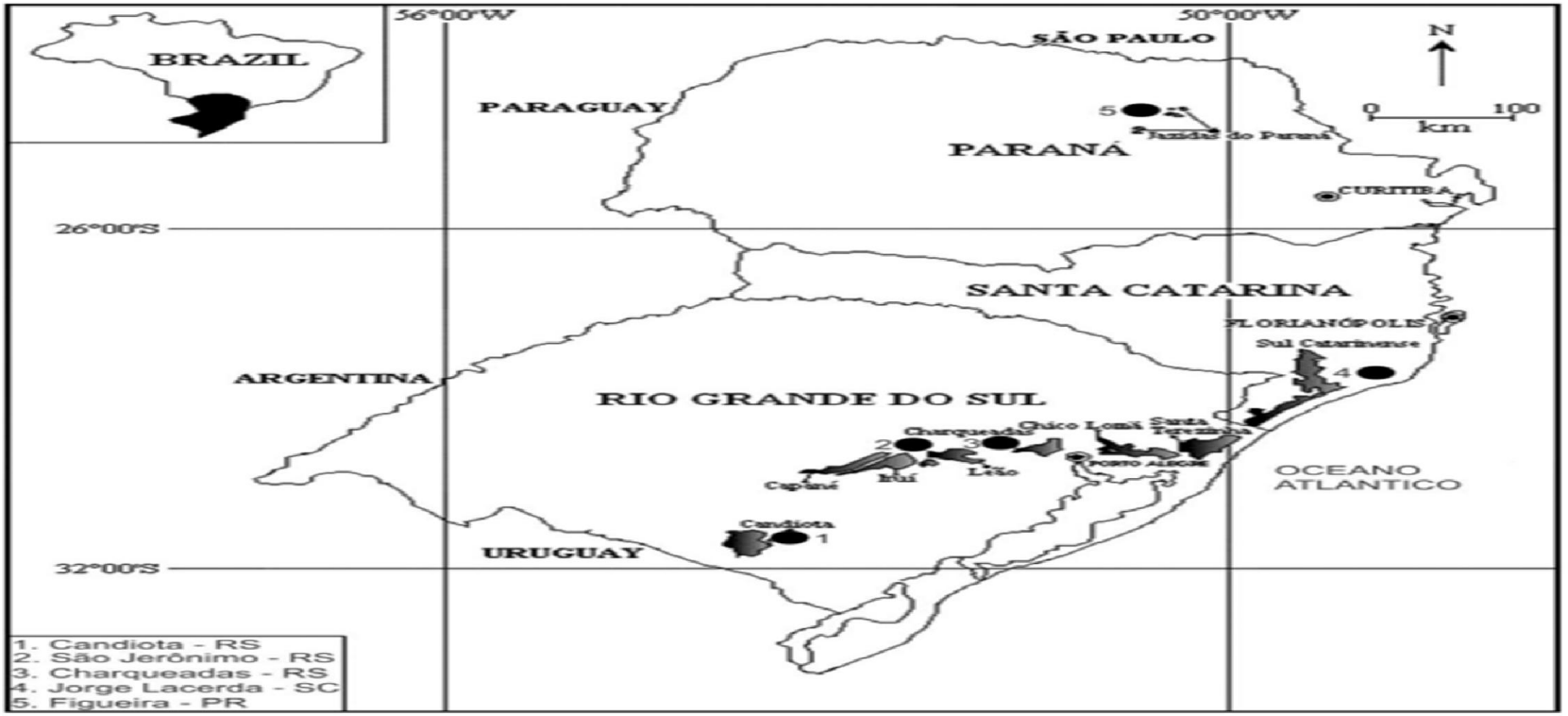

Fig. 1: Location of sample sources, and also of Jorge Lacerda (Tractebel-Suez) power station


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511 m
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- Lake whith pH 2,9.

Pyrite, Jarosita (orange).

- Lake whith high consentrations of em Fe^{2+} e Fe^{3+}

5th International Workshop - Advances in Cleaner Production

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Academic Work

Objectives of the present study

•The intention of the present study is to compare the mineralogical and inorganic geochemical characteristics of ROM and beneficiated coals from the principal mines and preparation plants in Santa Catarina that contribute to the blend used in the Jorge Lacerda power station, in order to evaluate the partitioning of the minerals, major elements and trace elements by the beneficiation processes used.

Methods

•Were collected (12 ROM and 12 beneficiated or clean coals), a total of 24 coal samples, from both large and small mines of Santa Catarina (fig 1) . Bulk samples of 100 kg were collected over a 5-day period from each site immediately after the mining and beneficiation processes.

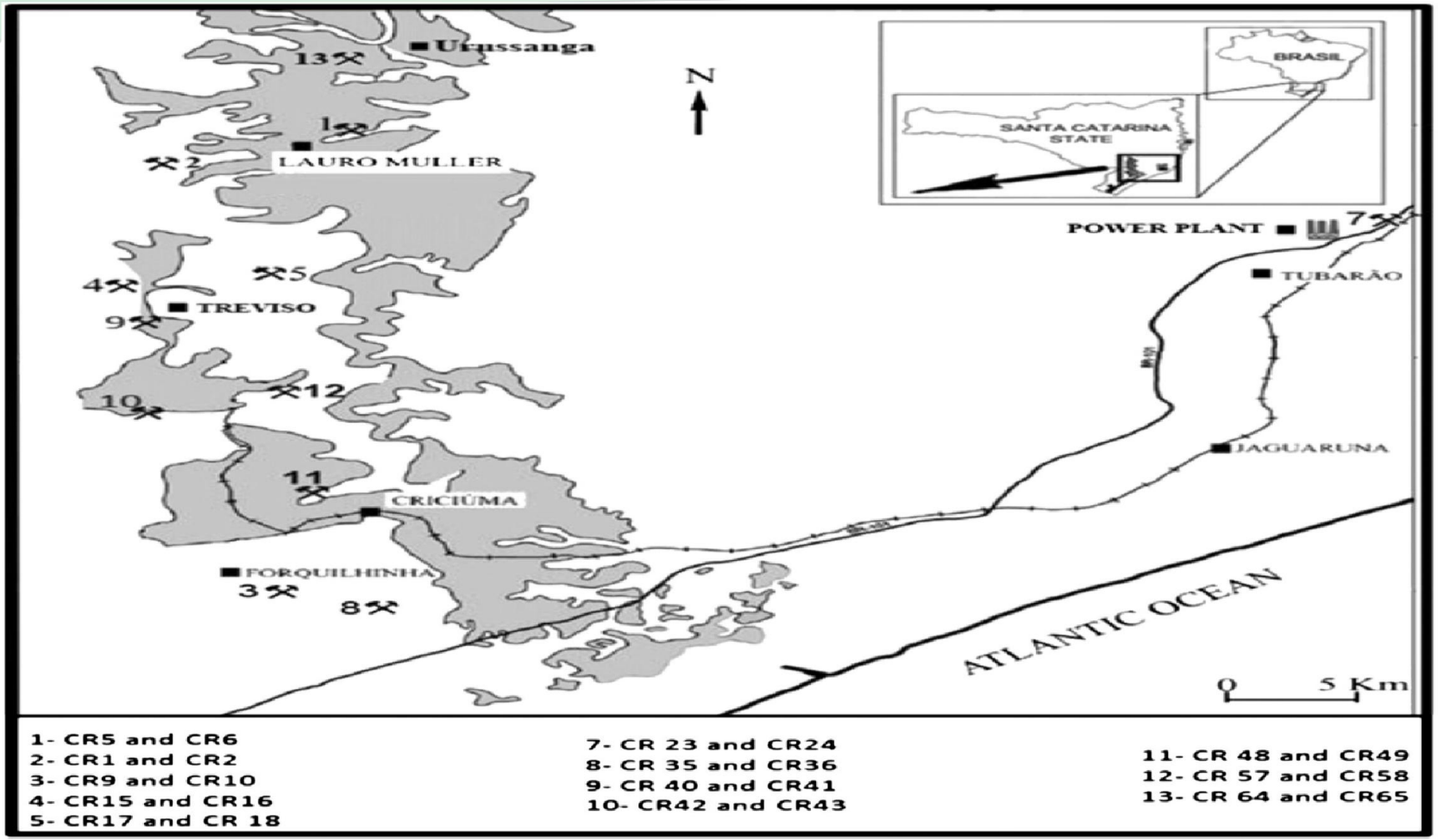
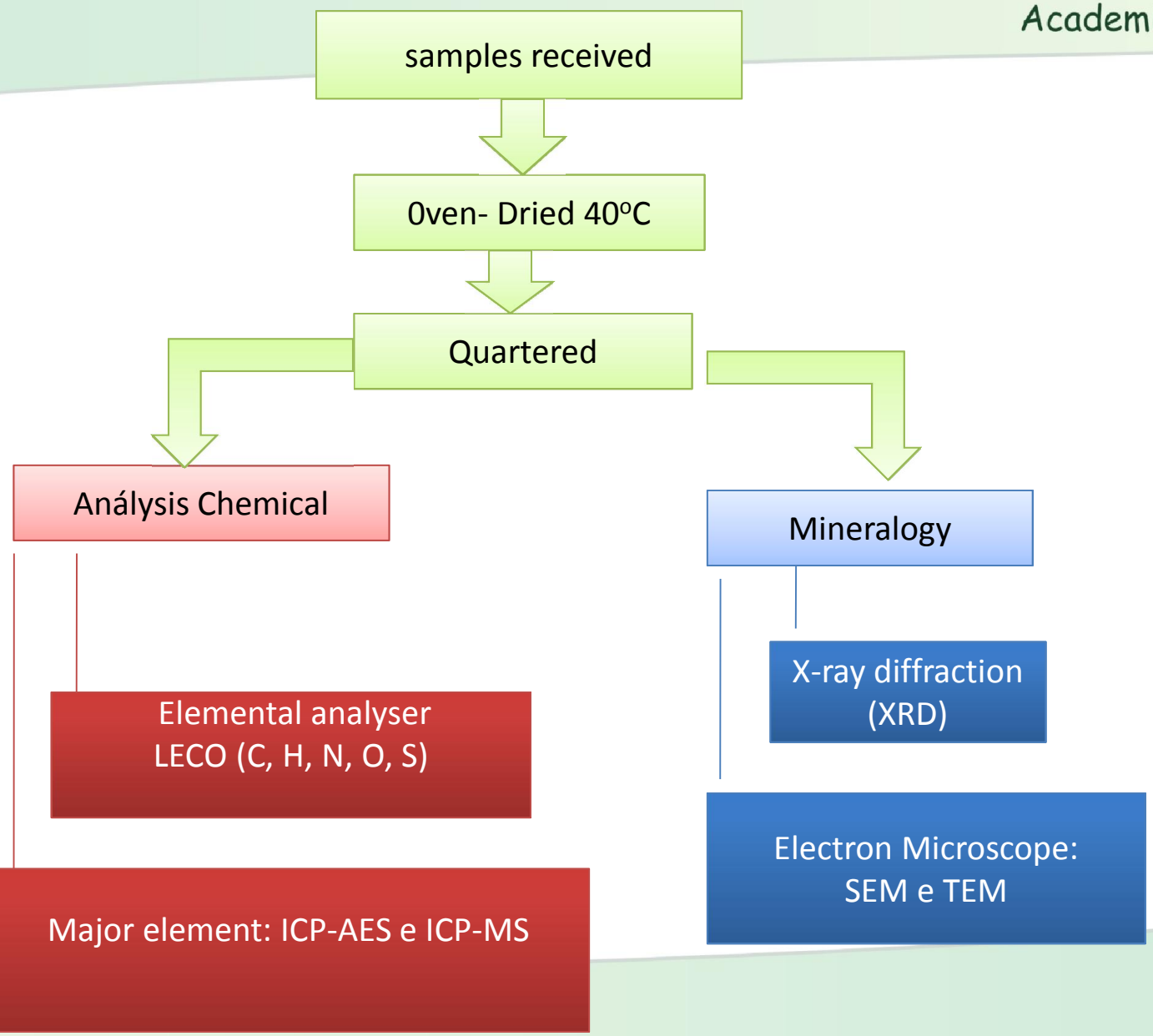


Fig. 1. Location of sample sources, and also of Jorge Lacerda (Tractebel-Suez) power station.

Table 1
Source of coal samples used in this study.

Sample	Company	Mine	Coal seam	Sample type
CR 1	Carbonífera Catarinense Ltda.	3G Plano II	Barro Branco	Run-of-mine
CR 2	Carbonífera Catarinense Ltda.	3G Plano II	Barro Branco	Clean coal
CR 5	Carbonífera Catarinense Ltda.	Bonito	Bonito	Run-of-mine
CR 6	Carbonífera Catarinense Ltda.	Bonito	Bonito	Clean coal
CR 9	Carbonífera Criciúma Ltda.	Unidade Mineira II - Verdinho	Barro Branco	Run-of-mine
CR 10	Carbonífera Criciúma Ltda.	Unidade Mineira II - Verdinho	Barro Branco	Clean coal
CR 15	Carbonífera Metropolitana Ltda.	Fontanela	Bonito	Run-of-mine
CR 16	Carbonífera Metropolitana Ltda.	Fontanela	Bonito	Clean coal
CR 17	Carbonífera Metropolitana Ltda.	Esperança Leste	Barro Branco	Run-of-mine
CR 18	Carbonífera Metropolitana Ltda.	Esperança Leste	Barro Branco	Clean coal
CR 23	Rio Deserto Ltda.	Mina Barro Branco	Barro Branco	Run-of-mine
CR 24	Rio Deserto Ltda.	Mina Barro Branco	Barro Branco	Clean coal
CR 35	Cooperminas Ltda.	Mina 3	Barro Branco	Run-of-mine
CR 36	Cooperminas Ltda.	Mina 3	Barro Branco	Clean coal
CR 40	Carbonífera Belluno Ltda.	Morozini	Barro Branco	Run-of-mine
CR 41	Carbonífera Belluno Ltda.	Morozini	Barro Branco	Clean coal
CR 42	Carbonífera Belluno Ltda.	Cantao	Barro Branco	Run-of-mine
CR 43	Carbonífera Belluno Ltda.	Cantao	Barro Branco	Clean coal
CR 48	Carbonífera Belluno Ltda.	Morozini/Cantao	Barro Branco	Run-of-mine
CR 49	Carbonífera Belluno Ltda.	Morozini/Cantao	Barro Branco	Clean coal
CR 57	Gabriella Mineração Ltda.	Rio Fiorita	Barro Branco	Run-of-mine
CR 58	Gabriella Mineração Ltda.	Rio Fiorita	Barro Branco	Clean coal
CR 64	Carbonífera Siderópolis Ltda.	Lageado mine	Barro Branco	Run-of-mine
CR 65	Carbonífera Siderópolis Ltda.	Lageado mine	Barro Branco	Clean coal


samples received
0ven- Dried 40ºC
Quartered
Análysis Chemical
Mineralogy
Elemental analyser
LECO (C, H, N, O, S)
X-ray diffraction
(XRD)
Major element: ICP-AES e ICP-MS
Electron Microscope:
SEM e TEM

Analytical procedures

- Powdered (<212 μm) subsamples prepared from the ROM and clean coals were oven-dried for 24 h at 40 °C;
- LECO CNHS-932;

Providing data on the carbon,hydrogen, sulphur, nitrogen and oxygen contents of the dried coal samples;

- Other representative portions of each powdered coal sample were ashed at 815 °C;
- All analyzes were performed in duplicate. The development of this research.

Results and Discussion

- Ultimate analysis data for the ROM and clean coal samples are presented in (Table 2). The data in Table 2 represent values determined to a dry basis, so that the sum of the C, H, N, S and O percentages effectively represent the total proportion of organic matter.

Table 2
Ultimate analysis (wt. %, dry basis) of coal samples.

Sample	Company/mine	Coal	C	H	N	S	O	Total	Ash[a]
CR 1	3G Plano II	Run-of-mine	37.34	2.96	0.76	2.25	9.31	52.62	47.38
CR 2	3G Plano II	Clean coal	52.76	3.69	1.01	1.44	8.59	67.49	32.51
CR 5	Bonito	Run-of-mine	21.50	1.64	0.29	1.78	5.03	30.24	69.76
CR 6	Bonito	Clean coal	38.99	2.28	0.49	1.55	5.55	48.86	51.14
CR 9	UM II-Verdinho	Run-of-mine	26.68	1.95	0.49	2.11	5.10	36.33	63.67
CR 10	UM II-Verdinho	Clean coal	51.65	3.56	0.96	1.66	4.75	62.58	37.42
CR 15	Fontanela	Run-of-mine	36.45	2.06	0.47	2.34	3.83	45.15	54.85
CR 16	Fontanela	Clean coal	50.97	2.92	0.69	1.53	3.74	59.85	40.15
CR 17	Esperança Leste	Run-of-mine	36.51	2.84	0.78	2.02	5.41	47.56	52.44
CR 18	Esperança Leste	Clean coal	51.80	3.53	1.05	1.37	5.66	63.41	36.59
CR 23	Barro Branco	Run-of-mine	36.41	2.32	0.71	2.72	3.93	46.09	53.91
CR 24	Barro Branco	Clean coal	46.21	3.26	0.91	2.70	3.95	57.03	42.97
CR 35	Mina 3	Run-of-mine	45.43	3.09	0.90	1.75	3.91	55.08	44.92
CR 36	Mina 3	Clean coal	60.84	3.95	1.17	1.12	3.48	70.56	29.44
CR 40	Morozino	Run-of-mine	41.72	2.69	0.90	2.65	3.35	51.31	48.69
CR 41	Morozino	Clean coal	56.55	3.40	1.18	1.40	3.09	65.62	34.38
CR 42	Cantao	Run-of-mine	35.10	2.44	0.77	2.44	3.39	44.14	55.86
CR 43	Cantao	Clean coal	49.02	2.81	0.99	1.37	3.05	57.24	42.76
CR 48	Morozin/Cantao	Run-of-mine	12.52	1.58	0.39	2.38	2.62	19.49	80.51
CR 49	Morozin/Cantao	Clean coal	47.17	3.38	0.78	0.74	8.02	60.09	39.91
CR 57	Gabriela	Run-of-mine	8.09	1.10	0.08	0.99	5.71	15.97	84.03
CR 58	Gabriela	Clean coal	44.32	3.29	0.89	0.90	4.55	53.95	46.05
CR 64	Car. Siderópolis	Run-of-mine	11.23	1.25	0.11	3.91	6.10	22.60	77.40
CR 65	Car. Siderópolis	Clean coal	39.31	3.09	0.82	3.21	6.27	52.70	47.30
Average		Run-of-mine	29.08	2.16	0.55	2.28	4.81	38.88	61.12
Average		Clean coal	49.13	3.26	0.91	1.58	5.06	59.95	40.05

[a] Ash percentage estimated by difference.

Result

- A few trace elements, such as As, B and Pb, show an even greater reduction associated with beneficiation;
- The average percentage of pyrite in that mineral matter is also reduced by 67%.

Elements with concentrations increased by beneficiation

- For three of the elements, Ge, U and Zr, the average concentrations in the clean coals are significantly higher than in the ROM materials.

Minerals and major elements as fractions of whole-coal samples

- When considered on a whole-coal basis, the average proportions of quartz, kaolinite, illite and bassanite + gypsum in the clean coals are between 55 and 80% of the average proportions of quartz, kaolinite, illite + and bassanite + gypsum in the clean coals are between 55 and 80% of the average proportions of the same minerals in the ROM samples.

Conclusion

- Comparison of ROM and clean coal products from Santa Catarina preparation plants shows significant reductions in ash, mineral matter and total sulphur percentages associated with beneficiation, and also in the relative proportions of pyrite within the mineral matter.
- Quartz, kaolinite, illite and minor proportions of calcite and other accessory phases, and appears to have been little changed by coal preparation.

- The concentrations of As, Pb and B are reduced to a greater extent, consistent with the reduction in pyrite associated with beneficiation, 55%, 26% and 50%, respectively;
- Some elements, such as Ge, U, and possibly Zr, have higher average concentrations (i.e. >120% of the average ROM values);

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