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Tittel

The Results of the GeologicalMapping at Rånabogen Basic-Ultrabasic Intrusion, Ballangen Norway

Forfatter	Dato	År	Bedrift (Oppdragsgiver og/eller oppdragstaker)
Saarelainen, Antti	15.12	1997	Outokumpu for Nikkel og Olivin A/S

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Ballangen	Nordland		13311	Narvik

Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
Malmberegning		Råna Rånabogen Arnesfjellet

Råstoffgruppe	Råstofftype
Malm/metall	Ni, Cu

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Beskriver geologisk kartlegging for å finne mulige Ni-førende bergarter i Rånabog-området. området består av noritter, olivinnoritter, peridotitter og ikke-intrusive bergarter.
Alle bergarstyper har spor av sulfider, Olivinnoritten kan ha opp til 0,25% Ni.
Det antydes at det neppe er trolig det finnes høygehaltlige forekomster innenfor undersøkelsesområdet. det foreslås likevel videre undersøkelser.

Vedlagt geol. kart, samt analyse/bergartstype oversikter.

outokumpu

NIKKEL OG OLIVIN A/S 15.12.1997

Antti Saarelainen:

THE RESULTS OF THE GEOLOGICAL MAPPING AT RÅNBOGEN BASIC-ULTRABASIC INTRUSION, BALLANGEN, NORWAY

1. Introduction
2. Geology
3. Mineralisations
4. Conclusions and possible further operations

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BASE METALS
BUSINESS AREA

1. INTRODUCTION

Rånbogen area is located 20 kilometers southwest of Narvik town. Geologically Rånbogen is located at the northwest part of Råna basic massive intrusion. The intrusion is about 75 sq. kilometers wide and it consists mainly of quartz norites, norites, peridotites and pyroxenites. During the last eight decades has the intrusion been several times an exploration target for prospectors, mainly for nickel and copper. Today there is one operating low-grade nickel mine at Arnesfjellet, at the west contact of the intrusion.

The aim of the work was to map and find possible nickel bearing mafic-ultramafic rocks in Rånbogen area. Rånbogen area consists mainly of noritic rocks, but there are several ultramafic beds inside norites. In the 1970'ies Geological Survey of Norway (NGU) mapped, drilled two holes and excavated small test pits for Stavanger Steel in Rånbogen (Boyd & Mathiesen, 1973). Yet, the exploration target for NGU was the hole massive, not only Rånbogen area. In 1996 a detailed airborne magnetic and electric study was done by Nikkel og Olivin at the area of Arneshesten-Rånbogen. This study raised up some interesting geophysical anomalies, which were partly activating Nikkel og Olivin for this work. Mapping was started in October, but after three weeks the work had to be stopped because of snowfall. Mapping area is spread into four 1:5000 map sheets, i.e. EO241-5-2 and 4 and EP241-5-1 and 3.

2. GEOLOGY

Rånbogen area is topografically quite steep. The western part of the mapping area is restricted into the sea and eastwards terrain rises up into 1200 meters at the peak of Rånkeipen. Highest levels mapped during this work were about 400 meters above the sea level. The west part of the area is unexposed to the altitude of 40-75 meters. In the north, closer to river Rånbog, first outcrops appear between 125-150 meters high. Nevertheless, lowest outcrops are always in small creek canyons, which are fairly numerous in the area. At the lower altitudes unexposed areas are covered by fairly thick glacial till deposits, at the higher altitudes amount of erosional debris increase.

2.1. Norites

The most common rock type in Rånbogen area is norite. It is usually medium grained and fairly homogenous greenish-grey rock with plagioclase and orthopyroxene. In some places there are smaller horizons or inclusions where the rock is banded. Quite often this thinly banded rock is also folded. Contact between a homogenous norite and a banded norite seems to be sharp (reference outcrop P4). This banding is probably primary magmatic layering, but other origins, like tectonism during crystallisation may be possible. Norites are usually unmineralised, but at higher altitudes fine grained pyrrhotite dissemination is fairly common (outcrop P7). Un-depending on the degree of mineralisation, the magnetic susceptibility is always under 40 (SI-units x 10^{-5}).

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2.2. Olivine norites

Olivine norites can be divided into two types. More common type is a norite with small amounts of olivine. Genetically these norites are close to normal norites (2.1). In the mapping area they usually occur at higher altitudes. Very fine grained, obviously primary sulphide dissemination is common and the total nickel content is 0.35 % Ni (outcrop P16). Magnetic susceptibility of this type is low. Another type of olivine norite is genetically close to peridotites. This rock type is dark green with olivine, pyroxenes and about 10 % plagioclase. On the mineralogical basis this rock is close to peridotite and could be classified as a 'plagioperidotite'. This type has a fairly weak, but relatively coarse grained and 'good looking' primary dissemination of pyrrhotite and calcopyrite and the rock could be a possible host for a nickel ore. Metal contents of two analysed samples are 0.25 % Ni and 0.1 % Cu (outcrop P1). The maximum value of the magnetic susceptibility for this type is 2000 SI-units (x 10^{-5}).

2.3. Peridotites

About 20 % of the mapping area consists of ultramafic intrusives. These different peridotites occur as beds inside the norite. Beds are several tens of meters thick and they seem to dip steeply southeast. Mineralogically there are two different types of peridotites, which differ only slightly from each other. First type occur only at lower altitudes (up to 200 meters above sea level). First type is homogenous and massive coarse grained olivine rich peridotite with larger (up to 2 cm) orthopyroxene crystals. Quite often this rock has also large clinopyroxene crystals, which enclose great amounts of small olivine crystals. Texturally this rock can be named as an orthopyroxene-clinopyroxene orthocumulate. Slight alteration is common and has produced small quantities of flogopite and clorite. This peridotite has always weak primary dissemination of pyrrhotite and calcopyrite and it could be a good host for a nickel ore (outcrops P2, P11, P12, P21). This type has high magnetic susceptibility values (usually between 600-4000 SI-units) being probably explanation for the local airborne magnetic maximum.

Another type of peridotite is a medium and even grained rock with more pyroxenitic composition (P8, P23). This rock occurs at higher altitudes (over 225 meters), yet in the western part of the mapping area horizons of this rock come closer to the sea level (mapping unfinished). In the contact zones to norite, rock has a clear foliation (outcrop P8). This pyroxene-peridotite is mostly unmineralised or has only a very weak dissemination. Magnetic susceptibilities for this rock are low (<100 SI-units), but the foliated contact versions have higher values (up to 1200 SI-units). After all this peridotite type can also be considered as a potential host rock for an ore.

2.4. Non-intrusive rocks

Råna intrusion is surrounded by gneisses and mica schists of sedimentary origin. These metasediments are usually massive and they show quite stable orientation. They are very well exposed along the river Rånboga. Near the intrusion contact these metasediments have metasomatically altered producing contact metamorfic, 'hornfels-type' rocks (outcrop P5). These banded, gneissic rocks have typically greater amounts of different Ca-rich silicates and carbonates. Previously they have been mapped as 'calc-silicate-gneisses'. They may also occur as inclusions or xenoliths inside the intrusion body. Neither the metasediments nor the 'hornfelses' do show anomalous magnetization.

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3. MINERALISATIONS

In Rånbogen area can almost all different intrusive rock types be found with a segregated sulphide phase. Mineralisations can generally be divided into two different types. The first, economically most interesting type is syngenetic, primary dissemination of sulphides. The second type observed in the area is epigenetic mineralisations in contact, fault and thrust zones. Both type have anomalous nickel contents.

Ultrabasic differentiates (peridotites and olivine norites) have usually primary sulphide dissemination. Usually dissemination is weak or very weak and the total Ni-content is about 0.1 %. In some places, especially olivine norites ('plagioperidotites') have higher nickel contents with relatively weak dissemination (outcrop P1). In outcrop P1 sulphides have coarser grain size and both pyrrhotite and calcopyrite can easily be recognised. Ni-content of this rock is 0.25 %. This place is quite poorly exposed, but the rock horizon seems to be couple of meters thick and have lateral extensions. Another type of olivine norites (occuring at the higher altitudes) has usually fine grained, but fairly good sulphide dissemination (outcrop P16). Ni-content of this type is about 0.35 %. The genesis of the dissemination in this type is not totally clear and needs more investigation (see text later).

Economically less interesting mineralisations in Rånbogen area are those, which are of secondary, i.e epigenetic origin. These mineralisations are associated with contact, fault and thrust zones, which means, that sulphide bearing horizons may have lateral extensions, but horizons are relatively thin in nature. Due to the tectonic setting these horizons may also be quite difficult to follow. This type of horizon was found at the center part of the mapping area (outcrops P19, P25) and it can be followed at least 100 meters in W-E -direction (mapping was stopped by the snowfall). The horizon is in a noritic host and the massive parts of the mineralisation grade about 1.5 % Ni. Sulphides occur as massive-semimassive lenses and stripes of irregular shape in a less mineralised norite. The maximum thickness of the horizon is less than 5 meters. In this horizon there are three small test pits, which are made in 1970'ies by Stavanger Steel A/S.

Also two other, similar kinds of mineralised horizons were found in the mapping area (outcrops P10 and P16). Outcrop P10 is exposed only couple of meters in a small creek canyon and cannot be followed laterally because of till cover. Outcrop P16 is located over 350 meters high and the dimensions of this horizon are unknown so far. Nickel content of outcrop P10 is 0.5 % and P16 0.36 %, respectively.

4. CONCLUSIONS AND POSSIBLE FURTHER OPERATIONS

Considering the size of Råna basic-ultrabasic intrusion, the possibilities for unknown, economically interesting mineralised bodies outside Arnesfjellet area are rather high. Yet, the intrusion has been several times under exploration, which may mean that voluminous high grade nickel ores are unrealistic. Difficult topographic conditions also set restrictions when targetting exploration in Råna intrusion. The following list includes suggestions for possible further operations at Rånbogen area:

- mapping started in October 1997 should be finished (western parts of the area)
- the most interesting geophysical anomalies in the surroundings could be included in the study
- at the lower altitudes, where the till cover is thick (outcrop P1 and surroundings) detailed field geophysics is recommended (Scintrex-measurements, gravimetric measurements)
- the actual genesis of observed mineralisations needs more investigation (syngenetic-epigenetic)
- the geochemical nature of mineralised rocks at Rånbogen vs. Arnesfjellet could be surveyed
- more interest could be set to contact zones between intrusive and non-intrusive rocks (see Arnesfjellet)
- the dimensions of mineralised horizons could be surveyed by light drilling methods
- re-evaluation of the hole Råna massive based on previous works (Boyd & Mathiesen, 1973)

appendices:
1) Rånbogen 1997, outcrop and boulder observations and XRF-analyses
2) Rånbogen: XRF-analyses
3) Rånbogen: Geological map

references:
Boyd, R. and Mathiesen C.O., 1973, Geologisk kartlegging av Rånamassivet, Stavanger Steel A/S, Norges Geologiske Undersøkelse, Rapport nr. 1173 A.

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RÅNBOGEN 1997

OUTCROP AND BOULDER OBSERVATIONS and XRF-ANALYSES

ANTTI SAARELAINEN / NIKKEL OG O OLIVIN/ MAP SHEETS 1:5000 EO241-5-2&4 AND EP241-5-1&3

OUTCROPS:

outcrop	X-coord.	Y-coord.	rock type	explanations	tectonics	Ni %	Cu %	S %	MgO %	SUSC (SI)
P1*	54235	6560	ol-norite	homogenous rock, medium grained, diss. syngen. sulphides (po,cp)		0.23	0.09	2.68	23.80	600-2000
P2	54180	6605	peridotite	homog. rock w. larger (1,5 cm) opx-grains, weak dissemination		0.09	0.02	0.57	30.40	800-4000
P3	54140	6625	norite	medium grained homogenous,grey-green rock without sulphides		0.01	0.01	0.32	11.10	<10
P4*	54045	6670	norite	disharmonically folded, primarily (?) layered						30
P5	54270	6610	calc-sil. gn	fairly stable orientation, banded by dark green and grey layers	S=358/80					40
P6	54185	6665	norite	homogenous, medium grained, fairly light coloured rock, no sulph.						40
P7	53750	6670	norite	fairly fine grained norite, fine grained dissemination of pyrrhotite		0.28	0.27	7.07	9.94	30
P8	53865	6700	peridotite	typical erosion surface, very weak dissemination of pyrrhotite		0.06	0.01	0.39	39.3	max 300
P9*	53760	6775	pxprd	pxnite-pxprd, only few grains of sulphides						80
P10*	54160	6360	norite	contact between norite and prd, sulphide rich (epigenetic?) horizon		0.50	0.25			30
P11*	54140	6400	peridotite	homog. rock w. coarser opx-crystals and little flogopite, weak diss.						600-2000
P12	54125	6415	peridotite	very similar to P11, weak dissemination of pyrrhotite		0.08	0.01	0.50	30.7	300-2000
P13	54080	6475	peridotite	prd-pxprd, relatively homogenous rock, weak dissemination (po,cp)						650
P14	53760	6645	norite	relatively pyroxene-rich rock without sulphides						20
P15*	53790	6660	pxprd	contact zone betw. norite and prd, fairly strong foliation, no sulph.	S=346/83					600-1200
P16	53715	6630	ol-norite	fairly fine grained rock w. fine grained diss. on pyrrhotite, see L4						
P17	53790	6615	pxprd	weakly foliated rock, no sulphides						40
P18*	53860	6500	pxprd	very similar to P17, without sulphides						70
P19	53925	6375	norite	semimass. sulphides (po,cpy), vein type epigenetic (?) min.,test pit		0.39	0.39	8.49	9.99	<20
P20	54405	6780	mica-gn	banded, fairly homogenous mica gneiss with stable orientation	S=166/72					<20
P21	54335	6760	calc-sil.-gn	hornfels type rock with white-green banding and Ca-silicates						<20
P22*	54280	6770	peridotite	fairly homogenous rock, little flogopite alteration, larger opx-grains						200-800
P23*	53900	7000	peridotite	prd-pxprd, homogenous rock without sulphides						
P24	54020	6245	peridotite	25 m thick bed inside norite, weak diss. of pyrrhotite		0.07	0.01	1.29	33.9	<60
P25	53920	6340	mass. ore	mass. pyrrhotite rich ore, vein type epigenetic min.(?), test pit		1.61	0.06	28.04	2.50	<60
P26	53920	6415	norite	noritic rock w. primary bedding, bedding partially tectonized (?)	L=318/88					20
BOULDERS :										
L1*	54240	6555	peridotite	homogenous rock w. larger opx-grains, weak dissemination						400
L2	54225	6640	peridotite	homog. rock, weak diss. of pyrrhotite, very local boulder		0.11	0.04	1.53	28.0	max 2500
L3*	54115	6430	norite	semimassive sulphide rich rock in noritic host; mainly po, little cp		0.33	0.16	6.52	23.1	<100
L4	53725	6610	ol-norite	fairly fine grained rock w. fine grained, homog. diss., similar to P16		0.36	0.08	4.86	27.5	

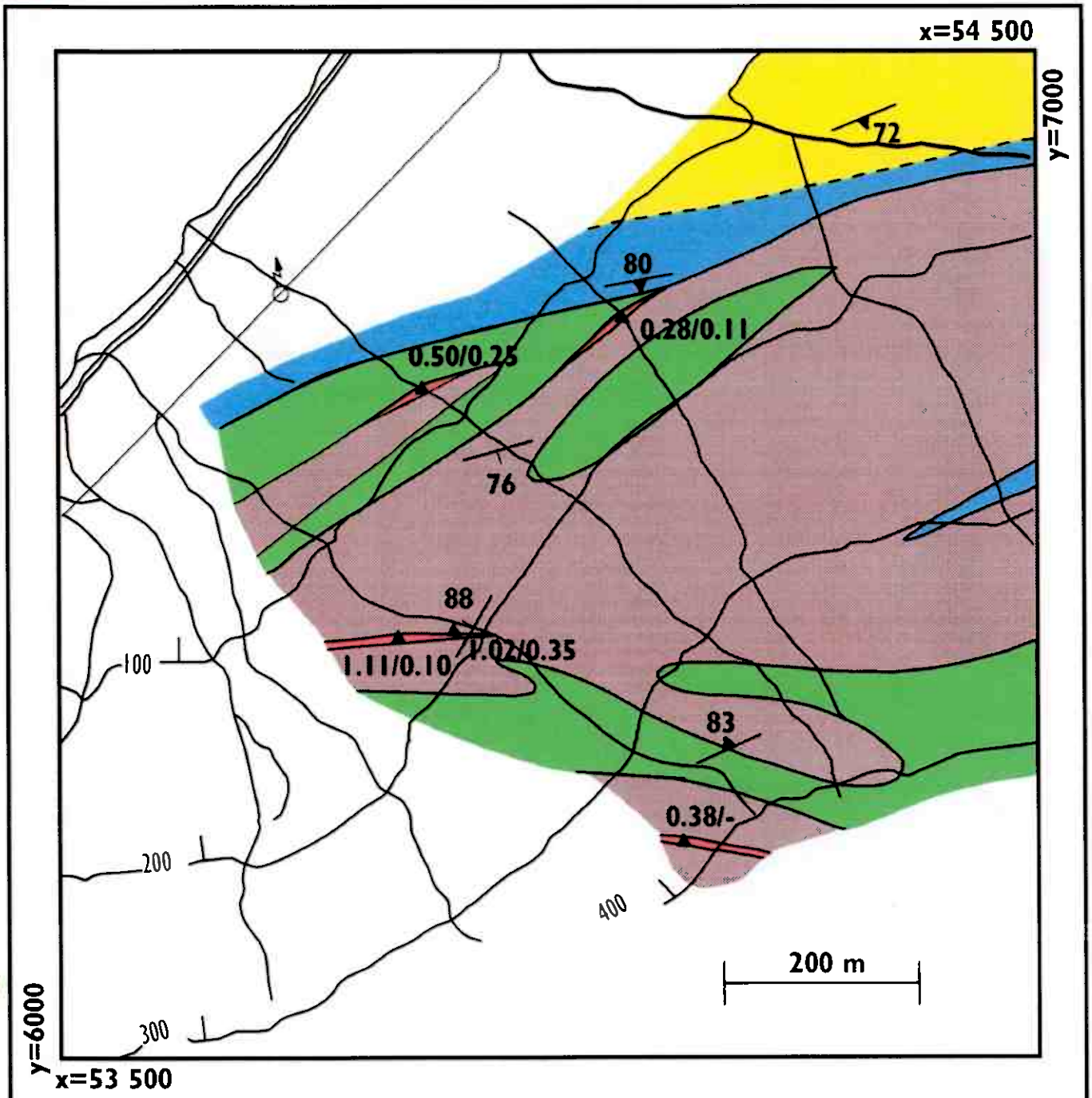
*) reference sample exist at N&O

RÅNBOGEN: XRF-ANALYSES (%), 11/1997

number	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Rb2O	SrO	BaO	Na2O	K2O	Cu	Ni	Co	S
P1	42.0	0.309	8.84	0.213	14.80	0.159	23.80	4.99	0.0015	0.0094	0.004	0.97	0.377	0.087	0.230	0.028	2.68
P2	41.9	0.444	5.98	0.049	14.60	0.190	30.40	3.19	0.0013	0.0113	0.008	0.81	0.277	0.019	0.089	0.016	0.57
P3	51.3	0.378	17.70	0.093	6.58	0.124	11.10	9.44	0.0016	0.0315	0.010	1.77	0.388	0.008	0.013	0.011	0.32
P7	41.2	0.172	15.30	0.137	16.00	0.096	9.94	10.10	0.0009	0.0175	0.004	0.88	0.069	0.267	0.283	0.040	7.07
P8	40.7	0.127	2.86	0.242	13.10	0.170	39.30	1.47	0.0009	0.0033	0.002	0.20	0.057	0.009	0.063	0.018	0.39
P10A	28.7	0.316	3.91	0.097	37.20	0.104	11.10	4.84	0.0012	0.0036	0.003	0.28	0.090	0.264	0.462	0.109	16.40
P12	42.7	0.246	5.30	0.043	14.90	0.196	30.70	2.88	0.0020	0.0091	0.008	0.59	0.313	0.013	0.078	0.018	0.50
P13	41.2	0.203	6.53	0.048	17.90	0.191	26.10	3.71	0.0011	0.0115	0.003	0.69	0.177	0.031	0.049	0.016	2.23
P19	38.3	0.241	14.10	0.228	21.30	0.130	9.99	6.70	0.0020	0.0150	0.006	1.06	0.302	0.390	0.385	0.048	8.49
P24	39.8	0.123	3.29	0.059	17.20	0.204	33.90	2.31	0.0006	0.0054	0.003	0.30	0.059	0.011	0.066	0.022	1.29
P25	10.9	0.109	3.74	0.056	57.00	0.025	2.50	2.47	0.0005	0.0032	0.004	0.37	0.058	0.061	1.610	0.176	28.4
L2	42.1	0.246	5.81	0.048	16.10	0.190	28.00	3.35	0.0027	0.0085	0.005	0.63	0.623	0.040	0.111	0.019	1.53
L3	41.6	0.196	4.62	0.260	20.80	0.177	23.10	2.67	0.0008	0.0040	0.002	0.27	0.045	0.161	0.335	0.040	6.52
L4	39.0	0.079	6.93	0.230	17.50	0.124	27.50	3.14	0.0008	0.0066	0.002	0.40	0.036	0.081	0.361	0.037	4.86

n=14

outokumpu



RÅNBOGEN

GEOLOGICAL MAP

MAPS EO 241-5-2&4
EP 241-5-1&3

NIKKEL OG OLIVIN A/S

- NORITE
- PERIDOTITE PYROXENE PERIDOTITE
- CALC-SILICATE GNEISS
- MICA SCHIST MICA GNEISS
- SULPHIDE BEARING HORIZON
- NICKEL/COPPER GRADE (%)
- 100 CONTOUR (m)

AJS-97

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