COMMISSION OF THE EUROPEAN COMMUNITIES

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Brussels, 21 January 1975

Annual Report of Member States in accordance with Article 70 of the EAEC Treaty

Forwarding of Member States' reports to the Council by the Commission, in accordance with Article 70 of the EAEC Treaty

Draft opinion

1. In accordance with the provisions of Article 70 of the Treaty establishing the EAEC, the Member States have forwarded to the Commission the annual reports for 1972 on prospecting, production and investment in mining which has been made or is planned in their territories in respect of uranium.

From these reports it is seen that:

The outlay on prospecting for uranium deposits in Member States' territories was approximately 4.5 million u.a. in 1972;

For a production cost of less than 10 u.a./lb U_3O_8, the reasonably certain reserves in Community territory amount to approximately 40 000 tonnes of uranium and additional resources are estimated at an almost equivalent amount; the deposits are situated mainly in France and Denmark (Greenland);

Community output, almost solely from France, was approximately 1500 tonnes in 1972.

2. According to the most recent estimates of the nuclear capacity to be installed in the Community, natural uranium requirements will increase very rapidly in the coming years, rising from 5000 tonnes per annum at present to 15000 in 1980 and approximately 40 000 in 1985. It should be noted, by way of example, that the reserves described above are roughly equivalent in quantity to the cumulative natural uranium requirements of the Community between now and 1980.

If Community requirements are to be met, account being taken of the time-lag between the finding of deposits and their exploitation (7 to 10 years), almost 40 000 tonnes of uranium must be located as additional certain reserves by 1975 and approximately 200 000 tonnes by 1980. Since it is unlikely that such reserves can be found in Community territory, supplies must be obtained from external sources.

The investments corresponding to the discovery and exploitation of the resources required for the Community's supply of natural uranium, estimated on the basis of the comparable costs for 1973*, would be:

prospecting-exploration[1] = 45 million u.a./year in 1975 and
90 million u.a./year in 1980

exploitation-production[2] = 90 million u.a./year in 1975 and
180 million u.a./year in 1980

These assessments are given by way of example; they relate to investments which must be made long before they will yield profit.

3. Following examination of the reports forwarded by the Member States, the Commission:

considers it necessary to encourage prospecting and/or the acquisition of holdings in the territory of non-member countries by Community mining companies;

considers it necessary for the security and regularity of the Community's supply of natural uranium to be ensured at all events in the long term;

points out the value which indigenous resources could have as a strategic reserve and as a stabilizing factor in the event of temporary market tension;

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*1973 value of u.a.

[1]Based on 1 u.a./lb U_3O_8

[2]Based on 90 million u.a. for every 2000 tonnes per annum

considers that it is necessary to this end to continue prospecting for new deposits and to carry on with the exploration of deposits already identified, in order to determine their extent, without concentrating solely on resources with a low production cost.

4. The Commission draws the attention of the Council to the benefit which the Commission could derive from the availability of information on the activities of Member States' mining companies in non-member countries, as this would enable it to make an accurate assessment, in the general energy context, of the Community's situation as regards the supply of natural uranium.

Annual report of the Federal Republic of Germany for 1972, drawn up pursuant to Article 70(3) of the Treaty establishing Euratom

1. Prospecting

1.1 Territories for which permanent or temporary prospecting licences were held in Bavaria in 1972 are outlined in red on the appended map (Annex 1).

Concessions prospected during 1972 are coloured light red. Concessions to which this annual report is confined are emphasized in dark red.

Territories prospected before 1972 are hatched in black (without differentiating between hydrochemical prospection and special local methods of exploration).

Work planned for 1973 in the region of Baden-Württemberg under the priority programme of Uranium Prospecting in the Black Forest is not included on the map. It will be dealt with in the 1973 progress report.

1.1.1 The following zones were prospected in the concessions during 1972:

(1) Ludwigstadt zone
Silurian graptolite schists

(2) Weiden-Pressath-Hessenreuth zone
Rotliegende (Middle and Lower Permian)
Keuper (Upper Trias), Upper Cretaceous

(3) Fuchsmühl and Rosall zone
Metamorphic rock, granite

(4) Poppenreuth and Mähring zone
Metamorphic rock, granite, "Pfahlzone"

(5) Fürth i. Wald - Hoher Bogen, Altrandsberg - Cham zone
Metabasite, granite, "Pfahlzone".

Prospecting was confined to and concentrated on the above areas because, during previous prospecting years since 1957, these zones:

(a) were considered promising or proved to be fairly positive (e.g., the zones of Mähring, Poppenreuth, Uckersdorf, Altrandsberg);

(b) or were considered, on further reflection, as meriting wider or additional investigation or re-prospection (e.g., the zones of Weiden, Rosall, Fürth i. Wald).

Prospecting methods in the various concessions are shown on the appended map. Detailed geochemical prospecting in the promising zones was carried out on the basis of the following topographical maps: Donaustauf map No 6939, Zell am Marmersbach map No 7614

In the zone shown on the Donaustauf map, 12 000 soil samples and 40 rock core samples were taken and subjected to geochemical analysis.

In the zone shown on the Zell am Harmersbach map, 150 samples of stream alluvium and 1000 soil samples were taken and subjected to geochemical analysis. Work in Bavaria led to the discovery of numerous sites with maximum fluoride concentrations. The existence of workable deposits has not however been proven.

1.1.2 The following discoveries were made during 1972:

(1) Ludwigstadt zone

Results obtained in the region of Ludwigstadt confirmed those of previous years. The concentration of uranium in the Silurian graptolite schists varies from 10 to 90 ppm U_3O_8, the average value being about 40 ppm.

In uranium enrichment areas which occupied only very small volumes inside highly tectonic zones, the concentration reached 400 to 600 ppm U_3O_8.

Because of the low concentration, the reduced dimensions of the enrichment zones and the complex tectonics, prospecting was abandoned. The discoveries proved to be of no economic interest.

(2) Weiden-Pressath-Hessenreuth zone

Further prospecting has been carried out in the sediments of the Rotliegende (Middle and Lower Permian), the Trias (mainly of the Keuper-Upper Trias) and the Upper Cretaceous adjacent to the Saxothuringian and Moldanubian bedrock; these sediments, whose constituents are partially derived from crystalline rocks, have perhaps been enriched with detrital compounds or with high uranium content soluble compounds.

As in the case of previous research, no evidence was found of economically workable uranium deposits.

(3) Fuchsmühl and Rosall zone

Revision of old geological maps and the taking of further γ-metric and emanometric readings at the surface and in boreholes failed to provide any new information reliably indicating the presence of economically workable uranium deposits in these regions which, since 1957, have been considered as promising and have been prospected by various methods.

(4) Poppenreuth and Mähring zone

Oblique drilling was carried out to a depth of 500 metres in the uranium bearing quartz seam of Mäldi, near Mähring, where prospecting and drilling had already taken place in previous years; this

oblique drilling was intended to explore the extension of the uranium deposit to a distance of 650 metres to the south of the disused roadway.

At a depth of between 260 and 380 metres, the rock encountered was extremely quartzitic with occasional veins of ore rich in sulphides (pyrite, chalcopyrite, and lead sulphide), but no sign of any uranium mineralization was observed.

Near Poppenreuth (Höhensteinweg) drilling was carried out in a very small area (about 50 by 30 metres) in which anomalies had been observed in 1957 and which, in the light of previous research, had been booked as potentially interesting; 76 boreholes were drilled to a depth of 100 m. Interspersed in highly metamorphosed micaschists containing sillimanite and biotite from the pre-Cambrian era are granitoid, heavily kaolinized "mobilisats" incorporating mineralizations of apparently primary uranium in the form of pitchblende and coffinite. Secondary ores are also present (autunite, chalcolite, sabugalite, uranophane, phosphuranylite) and sulphides (pyrite and chalcopyrite).

A final assessment of the proven deposits, which are at the moment very small, is not yet possible.

(5) Uckersdorf-Ameisgrub-Kemnath bei Fuhrn zone

Areas where readings have been taken near Uckersdorf, Amaisgrub and Kemnath bei Fuhrn should be classified in the "Grosstruktur Pfahl-Flusspatrevier".

Intensive prospecting begun in previous years was resumed in these areas. Apart from the explanation of a few areas of radioactive anomalies, two new uranium mineralizations have been identified:

a) Near Uckersdorf am Forsterhof a vertical veined mineralization, varying in thickness from a few centimetres to 20 centimetres, and several metres long at a depth of about 9 metres, has been detected by test drilling; no horizontal or vertical extensions have been detected; the uranium concentration of samples lies in the percent range; the main mineral is uranophane, accompanied by autunite, chalcolite, becquerelite and pitchblende;

b) Near Kemnath-Fuhr-Luigendorf a mineralization containing autunite and pitchblende (accompanied by pyrite and fluorine), whose form and extent have not yet been determined, has been found at a depth of 30 metres.

(6) Fürth im Wald-Hoher Bogen-Altrandsberg-Cham zone
In this area, surface prospecting has been carried out in the Pfahlzone near Altrandsberg and around Cham and has yielded some further promising readings.

1.2 Work carried out in Bavaria in 1972 has revealed no new geological contexts, nor any radically new species of uranium bearing rock. However, mention may be made of veinlets of uranium mineralization (hitherto unencountered in Bavaria) in the granitoid "mobilisat" near Poppenreuth and pitchblendes discovered both at Poppenreuth and near Uckersdorf (Fosterhof) and Kemnath-Luigendorf, which indicates the presence of primary uranium ore enrichment zones.

In the Black Forest, areas of anomalies already discovered in January 1970 have been partially re-prospected. The anomalies are located in the metamorphic granite of Triberg, in the veins of porphyritic granite and in fractures of mylonitic zones some 10 centimetres thick.

Geochemical prospecting carried out by the mineralogical institute of Freiburg University has shown that, in the anomalies of the area round Hornberg and Niederwasser, apatite appears to be the carrier of the uranium in granite.

The apatite incorporates the mineralizations in the form of very finely crystalline cement, pigmented by hematite surrounding fragments of minerals and rocks of the breccia areas and Rötung. X-rays show the uranium bearing apatite as a binder filling the breccia and fissures. The origin of the phosphorus and the conditions of formation of the apatite have not yet been clarified.

1.3 State-subsidized prospecting in Bavaria was brought to completion in practically all areas in 1972. It is porposed to continue prospecting in 1973 in the mineralizations and deposits of Mähring (Wäldl), Poppenreuth (Höhensteinweg) and near Kemnath only.

1.3.1 Areas in which prospecting was carried out in 1972 are marked on the appended map. In the Black Forest, the work was limited to 19 anomalies already known.

1.3.2 Intensive prospecting by drilling was concentrated on a few important locations in Bavaria. Indicative depth (down to 140 metres maximum, one borehole attaining about 500 metres) and width of mesh were determined by local topographical conditions (width of mesh down to a minimum of 2 metres).

During geochemical prospecting, ground samples are taken on the basis of geological reference points and contour lines which are oriented in the direction of the assumed vein. The distance between sampling points along contour lines was generally five metres.

Stream alluvium samples taken from the Zell am Harmersbach zone were used for the development of analytical methods. Sampling methods were determined less by geological factors than by the need to obtain useful analytical material.

In the Black Forest experimental measurements were taken with the aid of scintillation counters for prospecting purposes. A total of four portable scintillation counters and two probes designed for taking measurements in boreholes were used.

In preparation for the radiometric measurements, the anomalous areas were systematically covered with networks of boreholes, excavations and drillings.

Boreholes

Using the COBRA rock drill: 179 holes over total of four anomalies

Distance from hole to hole	0.5 m
Depth	approx. 0.5 m
Total cumulated depth	89 m
Total area perforated	approx. 45 m^2

Using a STIHL excavator: 480 holes over total of three anomalies

Width of profile	20 m
Distance from hole to hole	1 m
Depth	1 m
Total cumulated depth	130 m
Total area perforated	17 600 m^2

Excavations

22 excavations over 13 anomalies: volume excavated 55 m^3

Drillings

With a rotary drill: 22 drillings over one anomaly

Width of profile	approx. 30 m
Distance from hole to hole	approx. 20-40 m
Depth	from 8-63 m
Total cumulated depth	905 m
Average depth	41 m
Total area perforated	approx. 8000 m^2

Land-based prospecting involved a total of 715 measurements over approximately 9 km and continuous radiometric readings over about 15 km.

In addition, a deep borehole ("Schramberg" thermic borehole of a depth of 655 m) was logged with the aid of a radiometric probe.

1.3.3 Cost of uranium prospecting in Bavaria in 1972

Federal State	DM	1 712 774.00	468 000 u.a.
Land of Bavaria (cost of personnel)	DM	26 000.00	7 100 u.a.
Private industry	DM	997 410.00	272 500 u.a.
	DM	2 736 184.00	747 600 u.a.

Cost of work in Baden-Württemberg

Federal State	DM	102 600.00	28 000 u.a.
Land of Baden-Württemberg	DM	25 650.00	7 000 u.a.
Private industry	DM	59 000.00	16 100 u.a.
		187 250.00	51 100 u.a.

1.3.4 Hopes of finding economically workable deposits in the north-east region of Bavaria have not increased since last year. At all events, they are still very slight.

Prospecting in the Black Forest will be continued, using methods already mentioned, on the basis of results judged encouraging so far. The maximum analytical contents of anomalies discovered last year amount to approximately 0.147% U_3O_8 (average concentration of all analyses amounts to 0.0542% U_3O_8).

If present prospecting were to reveal evidence of more important ore masses, it would be useful to open prospecting roadways in the richest ore bearing zones.

2. Mining and other work

2.1 No mining was carried out in 1972 except a few trenches.

2.2 Trenches are intended for prospecting. The corresponding lower costs are not specified.

2.3 It is not possible to make exact calculations of profitability on the basis of prospecting results obtained up to 1972.

It is, however, certain that no ore reserves workable at a cost of less than 8 u.a./lb of U_3O_8 are known at the present time. For costs ranging from 8 to 12 and from 12 to 25 u.a./lb, it may be estimated that proven reserves and probable reserves amount respectively to a few hundred and a few thousand tons.

3. Extraction

3.1 No extraction was carried out.

3.2 Irrelevant.

3.3 During the period covered by the report, production at the experimental ore dressing plant of Ellweiler near Birlenfeld (mainly from French ore) was as follows: 21 970.000 kg of ammonium diuranate, corresponding to 17 582.947 kg of U_3O_8.

3.4 Uranium ore dressing at Ellweiler involved the following costs:

by the Federal State	DM 1 000 000.00	273 200 u.a.
by private industry	DM 923 120.00	252 200 u.a.
	DM 1 923 120.00	525 400 u.a.

4. Estimated expenditure

4.1 (Revised expenditure for prospecting and

4.2 research during 1973)

(a) Inside the Federal Republic

by the Federal State	DM 2 900 000.00	792 300 u.a.
by private industry	DM 950 000.00	259 600 u.a.
by the Länder	DM 100 000.00	27 300 u.a.
	DM 3 950 000.00	1 079 200 u.a.

(b) Outside the Federal Republic

by the Federal State	DM 18 000 000.00	4 918 000 u.a.
by private industry	DM 6 000 000.00	1 639 300 u.a.
	24 000 000.00	6 557 300 u.a.

4.3 No public investment is planned for the extraction and processing of uranium bearing ores.

Table

Work carried out in various prospecting areas	UEGB Ludwigstadt	UEGB Weiden, Pressath, Hessenreuth	BGLA Area of Fuchsmühl around Rosall	GB Poppenreuth around Mähring	SBW Uckersdorf, Ameisgrub, Kemnath	GB Fürth i. Wald, Hoher Bogen, Altrandsberg
Measurements with portable radiometric equipment	-	14 profiles over 30.3 km of contour	1804 emanometric measurements over 17.5 km of contour	Radiometric and emanometric measurements (not counted)	159 km of contour	Radiometric and emanometric measurements (not counted
Measurements with vehicle-mounted radio equipment	-	41 profiles over 148.8 km of contour (19 500 measurements)	1 457 measuring points	-	85 km of contour, 20 751 measurements 34 spectrometric readings and 505 γ-measurements in boreholes	-
In boreholes of a depth of 1-6 m	3 064 holes	4 459 holes over 44 contours, 35.7 km	-	1 351 holes totalling 1 684 m (by the BGLA)	-	-
Individual holes (Einstich u. Stihlbohr)	Totalling 7000 m (12 780 measuring points)	about 8 403 m (2 330 measuring points)	-	-	-	-
Pneumatic drill down to depth of 63.5 m (Lufthammer)	-	16 holes of total length 710 m, 4 shafts, total 242 m	-	-	-	-

Table cont'd

In rotary drilled holes	59 holes, totalling 3 572.5 m	-	-	74 holes totalling 2 666 m	170 holes totalling 29 027 m	-
In core sampling holes	-	-	-	1 hole of 500 m 2 holes & 3 diggings totalling 333.8 m	7 holes totalling 353 m	-
Excavated materials	3 trenches 40.6 m^3	-	-	2 trenches about 15 m^3	8 trenches totalling 75 m length	-
Samples	230 (for analyses)	23 uranium determinations	-	No statement yet	10 239 samples 1 775 U determinations 910 analyses	Not counted
Geoelectric	-	-	ENSLIN method 150000 m^2	ENSLIN method 790000 m^2		

Uranprospektion durch Konzessionsinhaber in Bayern

M. 1 : 500.000

Innerhalb der Aufsuchungserlaubnisgebiete (z T schon vor 1957) von den Konzessionsinhabern oder in deren Auftrag mittels verschiedener Methoden durch gezielte Uranprospektion überdeckte Flächen

- Radiologische Messungen
- Auto- u Fußprospektion durch das BGLA
- zu Fuß (= örtliches Meßgitter, engmaschig)
- vom Auto aus (Carborne), z T auch vom Kraftrad
- vom Flugzeug aus (Airborne)
- Emanometer-Messungen in Gewässern
- E „ „ „ Bodenluft (örtlich u engmaschig)
- El Geoelektrisch, H_g Geomagnetisch
- Kern- und/oder Spülbohrungen
- Schlagbohrungen
- Untersuchungsbereiche (Kernbohrgebiet) mit kombinierten Methoden auf engem Raum (Emanometer-Messungen (Bodenluft), Geoelektrik, Bohrungen aller Art, z T Schurfe und Schachtchen)
- Uranfundpunkte
- Untersuchungsbergbau

~~Einzelheiten sind aus den Nebenkarten ersichtlich~~

1 2 3 4 5 6

Beilage zum Bericht vom 28.5.1973 Nr. 312i-IV-820

Bayer. Geologisches Landesamt München

- Äußere Umgrenzung der durch systematische Uranprospektion erfaßten Gebiete
- Während des Jahres 1972 zeitweilig oder durchgehend gültige Konzessionsgrenzen
- Konzessionsgebiete, in denen 1972 prospektiert worden ist, mit den engeren Prospektionsbereichen (dunkelrot)

BODENSEE

XVII/231/74-E

Office of the Permanent Representative of Belgium
to the European Communities

Brussels, 11 May 1973

Sir,

I am writing in answer to your letter of 13 March 1973 (Ref. 73/00532), sent from the Directorate-General for Energy and Euratom Safeguards, concerning the report which the Member States are required to submit each year to the Commission on the development of prospecting and production of uraniferous ores.

Since there is no prospecting at present under way in this field, the relevant Belgian authorities are unable to submit the summary report proposed by the European Commission.

(complimentary close)

J. Van Der Meulen
Permanent Representative

The President of the Commission
of the European Communities

For the attention of Mr F. Spaak
Director-General for Energy and Euratom Safeguards

rue de la Loi, 200
1040 Brussels.

Denmark's reply to the request for Member States' annual reports pursuant to Article 70 of the Euratom Treaty

1. Geographical situation

See appended map.

Zone A: existence of uranium at Kvanefjeldet (rock) in the Illimaussaq intrusion.

Zone B: zone prospected in 1971/72 in East Central Greenland.

2. General description of geological conditions and type of mineralization

Zone A: the uranium ores in the Illimaussaq intrusion are found in all the syenite rocks containing nepheline or agpaite.

The main types are:

(1) Lujaurite with "steenstrupin", and monazite;

(2) Metamorphic rock with "steenstrupin", thorite and monazite around masses of coarse-grained lujaurite;

(3) Hydrothermal grains in naujaite, mainly with "steenstrupin";

(4) Naujaite recrystallized in lujaurite mainly with "steenstrupin".

In Kvanefjeldet, where the most significant readings were obtained and studied in detail, the main types of mineralizations are as follows:

(1) Mineralization in coarse-grained lujaurite - high uranium concentration;

(2) Mineralization in coarse-grained lujaurite - low uranium concentration;

(3) Mineralization in deformed volcanic rocks;

(4) Mineralization in coare-grained lujaurite containing aegirine.

Zone B: The mineralization detected are listed under heading 3.

3. Present status in each region

Zone A: no uranium prospecting since 1969.

Zone B: prospecting in 1971/72.

(a) Aerial spectrometry and land-based radiometry;

(b) Two zones of mineralization of little importance have been discovered:

(1) At Milne Land, a placer containing mainly thorium in sandstones of the Upper Jurassic;

(2) A hydrothermal mineralization of uranium in the Stauning Alps in the contact zone between the syncaledonian granite and Permian arkoses. Accompanying minerals: fluorine, heavy baryte, secondary uranium ores.

(c) About Dkr 100 000 per year (13 500 u.a./year).

4. Present status of prospecting and mining in each region

Zone A: (a) Evaluation of the deposits of Kvanefjeldet was completed when the final calculations of tonnage and cost for hypothetical operating conditions were made;

(b) Proven reserves: 5 600 tons of uranium in ore containing more than 3000ppm of uranium. The ratio of thorium to uranium is about 2.6;

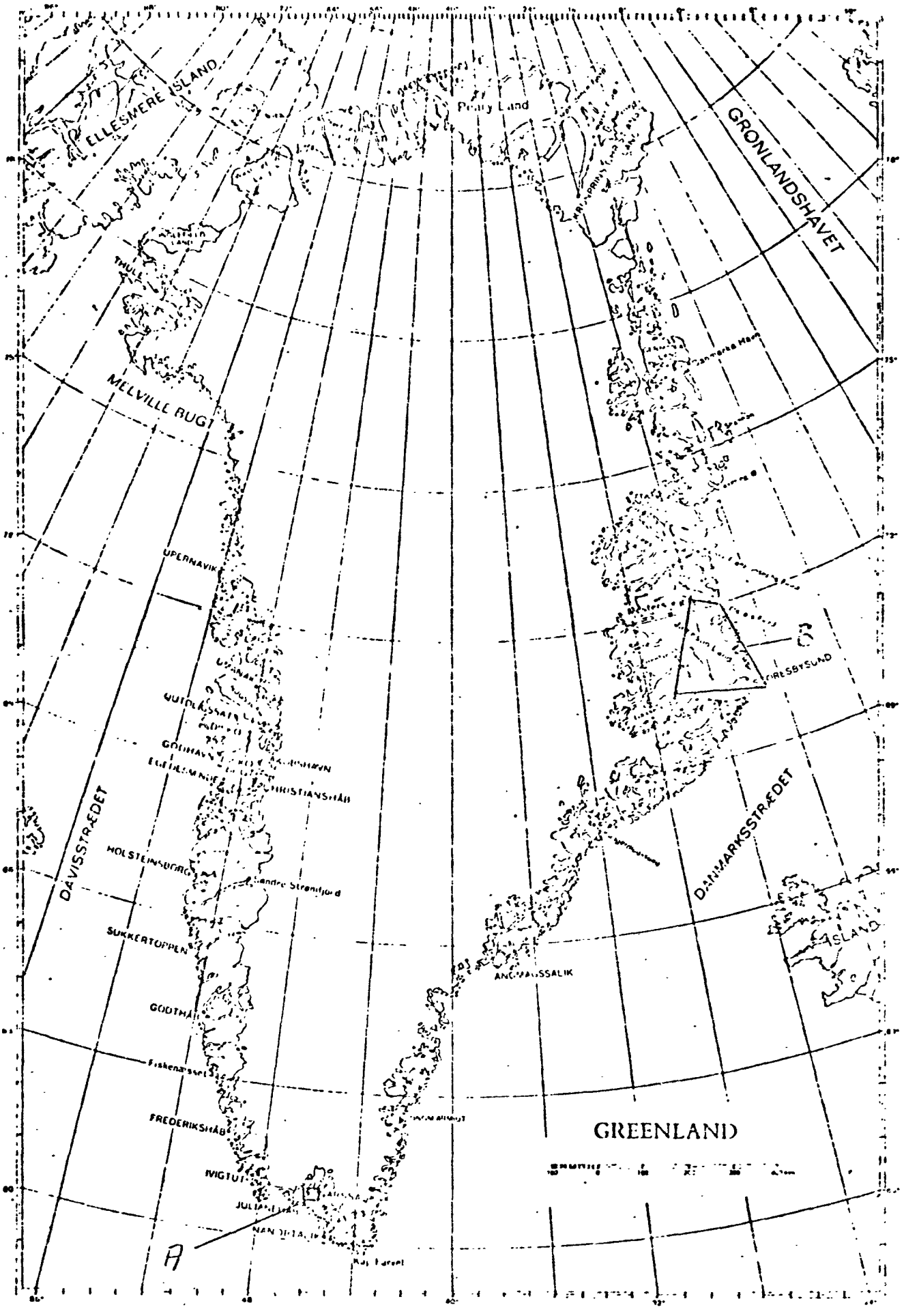
(c) Probable reserves: 15 000 tons of uranium (including proven reserves) in ore containing more than 300 ppm uranium. The ratio of thorium to uranium is about 2.6;

(d) No ore was extracted during 1972;

(e) Irrelevant;

(f) If the decision is taken to start working, total investment is estimated to be Dkr 190 million (25.4 million u.a.).

Zone B: the mineralization is only known as yet in the form of readings and consequently no detailed information can be given under (a) to (f).


ELLESMERE ISLAND
Peary Land
GRONLANDSHAVET
THULE
MELVILLE BUGT
UPERNAVIK
DAVISSTRÆDET
HOLSTEINSBORG
SUKKERTOPPEN
GODTHÅB
FREDERIKSHÅB
IVIGTUT
JULIANEHÅB
FIRESBYSUND
DANMARKSSTRÆDET
ANGMAGSSALIK
ISLAND
GREENLAND
A
B

Uranium prospecting and production on French territory
(pursuant to Article 70 of the Euratom Treaty)

1. Maps

The following maps, updated for 1972, are appended:

1) Location of main areas of uranium prospecting and production in France in 1972;

2) Area map of the Mining Division of Crouzille (CEA);

3) Area map of the Mining Division of Vendée (CEA);

4) Area map of the Mining Division of Forez (CEA);

5) Area map of the Mission of Hérault;

6) Area map of the Mission of Var.

2. Present status

Introduction

The CEA has carried out extensive prospecting for uranium on the national territory, both in granite country (in the neighbourhood of vein-bearing strata in the three mining divisions of Crouzille, Forez and Vendée) and over the Permian sedimentary formations where prospecting missions are operating at the present time.

In each of the three divisions, where the ores from the mines and nearby quarries are processed at a beneficiation plant, there are two objectives to the work in hand: one is to draw up the fullest possible inventory of uranium bearing deposits by prospecting and systematically studying all the readings with the aid of very precise methods of investigation, and the other is to assess, on the basis of proven or possible reserves, the potential yield of the deposits discovered.

Encouraging results have been obtained by the prospecting missions in the Permian areas of Rouergue, and Var, and in the small basin of Cérilly in the department of Allier. In the Permian basin of Lodève, the discovery of extensions to the deposits of Mas d'Alary/Mas Lavayre has confirmed the interest of this uranium bearing district.

Private companies have developed their activities mainly in the departments of Creuse, Aveyron and Haute-Vienne, and in Brittany.

In 1972, France produced 1 380 tons of uranium (inclusive of the products of lixiviation).

Private producers contributed 110 tons to this total figure.

Region of the Mining Division of Forez

This region, which in fact corresponds to the north-east quarter of the Massif Central, includes the following departments: Allier, Saône-et-Loire, Rhône, Loire, Puy-de-Dôme and Haute-Loire. The principal geographical and geological zones in which the work was carried out are: Morvan, the Permian coal basin of Blanzy, the Tertiary "Limagnes" of Loire and Allier, the mountains of Bourbonnais, Livradois, Forez, Beaujolais and Lyonnais, and the Tertiary basin of Montbrison.

Prospecting has ceased in Morvan, except in the northern part of the Luzy batholith. Work has also finished in the western region of Châtel-Guyon, the former territory of the prospecting missions of central and northern Auvergne. Work has stopped in the basin of Montbrison where the deposit of Grézieux-le-Fromental does not appear to be workable at the present time. The extensive programme of drillingsundertaken in the Blanzy basin, where a large number of significant readings had been obtained, did not yield to expected

results; work has stopped until further notice. Prospecting in the northern part of the Livradois massif has been abandoned.

On the other hand, work is continuing steadily in the Lyonnais and Beaujolais mountains where significant constellations of readings are being studied, and in the southern part of the Livradois massif in the Chaise-Dieu region where a prospecting licence has been applied for.

A prospecting team is at work in the region of Bourbon l'Archambault over the small Permian basin of Cérilly, close to the Tronçais forest. A programme of systematic drillings conducted on the basis of surface readings has revealed the presence of a small uranium bearing deposit whose possible extensions are at present being studied. Most of the production of the Forez Division comes from the Bois Noirs mine where extraction is proceeding as planned and should be completed towards the end of this decade.

Small uranium bearing deposits are also being worked by quarrying in the Château-Chinon region of the north and in the Ambert region of the south.

Region of the Mining Division of Crouzille

The heart of the working zone of the Crouzille Division corresponds geologically to the two-mica granite massif of the Ambazac mountains. Prospecting has been extended to the small massif of the Blond mountains in the west and to the St Gousseaud massif in the east. In the north, prospecting has extended well over the granito-gneisses which separate this central zone from the two-mica granite band of Basse-Marche where the Dong-Trieu company (now a subsidiary of the Empain-Schneider Group) is working. Prospecting teams have also been working in the region of the Millevaches plateau and on the borders of Périgord and Limousin on the small St Mathieu massif.

These activities extend over the departments of Charente, Creuse, Dordogne, Vienné and Haute-Vienne.

Although no significant discovery has been made outside the massif of the Ambazac mountains, not only has the extracted uranium been renewed but major extensions have been discovered running from the known deposits of Margnac and Fanay. Further north, work is in hand to study the group of deposits of Villard, Magnelles and Bellezanne where it is hoped to find substantial additional reserves.

Production has ceased this year at the Brugeaud quarry, but is continuing at the Margnac and Fanay mines where cross-cuts are being driven towards the extensions of formations already studied by drilling, while the Vincou stream is being diverted through a tunnel to allow working in the Peny zone.

The Dong-Trieu company is engaged in systematic development on the basis of readings obtained in the Basse-Marche area; it has obtained interesting results, especially at Piegut, Bernardan and Mas Grimaus. In Creuse, the Compagnie Française des Minerais d'Uranium (CEMU) and the Société Centrale de l'Uranium et de Minerais et Métaux Radioactifs (SCUMRA) hold mining licences under which work is temporarily at a halt.

Region of the Mining Division of Vendée

The operating zone of the Vendée Division corresponds basically to the granite massif of Mortagne-sur-Sèvre, but prospecting has been undertaken to the north of the Loire and has revealed a small lode in the Guérande region.

Prospecting has continued in the departments of Loire-Atlantique, Maine-et-Loire, Mayenne, Deux-Sèvres and Vendée.

At present it is mainly concentrated at the south-east tip of the Mortagne massif and along its northern edge in the Roussay region, where prospectors believe they have discovered a deposit likely to be a suitable successor to those now being worked.

Three mines are in operation: Chardon, Escarpière and Commanderie. The mine at Chapelle Largeau was closed in 1970 when the deposit had been worked out.

Massif Armoricain

Prospecting and production in this region has been carried out entirely by private companies. At present, the Société Industrielle et Minière de l'Uranium (SIMURA) is working alone in the department of Morbihan after winding up production in its deposit at Bonote (1971); the company is producing from the deposit of Bosglas and systematically investigating all the readings taken.

Southern part of the Massif Central

In the Permian basin of Lodève (Hérault), the CEA has continued drilling to investigate surface readings. It has thus determined the limits of the deposits of Mas d'Alary and Mas Lavayre where it is planned to begin production during the next decade.

A prospecting team is operating in the region of Rouergue where uranium bearing strata not yet economically workable have been detected in the Permian areas of the pass of Rodez (Aveyron).

In Cantal, work has ceased temporarily in the St Pierre deposit of the Société Centrale des Minerais et Métaux Radioactifs (SCUMRA), and the company is continuing prospection in Aveyron in the Permian zone of Brousse adjacent to the Basin of St Afrique.

In Lozère, the Compagnie Française des Minerais d'Uranium (CFMU) is processing ore from its Cellier deposit by lixiviation.

Var

A CEA prospecting mission now established at Vidauban aims to study the Permian basin of Var between Esterel and Toulon on the northern and eastern edges of the crystalline massif of the Maures. Uranium bearing deposits have been found. The work in hand will reveal the extent of their economic interest.

3. State of reserves at 31 December 1972

Potential metropolitan reserves of uranium have been increasing steadily in recent years despite a progressive rise in production.

On 31 December 1972, proven reserves in French territory amounted to 35 000 tons. Foreseeable reserves bring the total up to 59 000 tons.

4. Funds devoted to prospecting in 1972

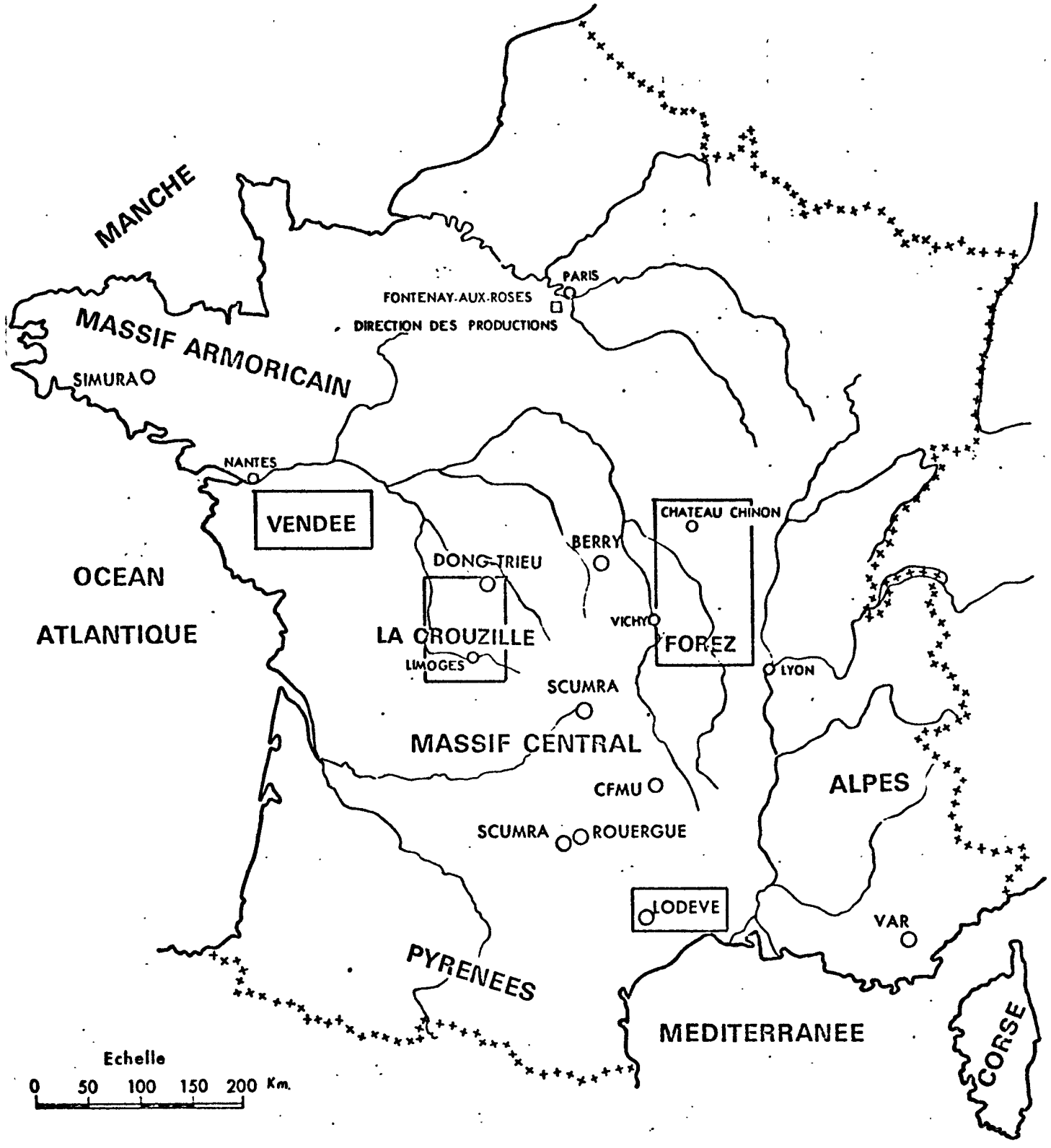
The funds devoted by the CEA to general prospecting in metropolitan territory in 1972 amounted to FF 7 561 000.

Taking into account the funds devoted to prospecting around deposits now being worked as well as general prospection, the total amount is FF 15 126 000.

This figure may be broken down as follows:

Region of the Division of Forez	FF 3 667 000
Region of the Division of Crouzille	FF 2 433 000
Region of the Division of Vendée	FF 2 524 000
Prospecting Mission (south of Massif Central and Var)	FF 6 502 000
	FF 15 126 000

LOCALISATION DES PRINCIPALES ZONES D'ACTIVITE DE RECHERCHES ET D'EXPLOITATION DE L'URANIUM EN FRANCE EN 1972



DIVISION DE LA CROUZILLE

ECHELLE :1/1.000.000

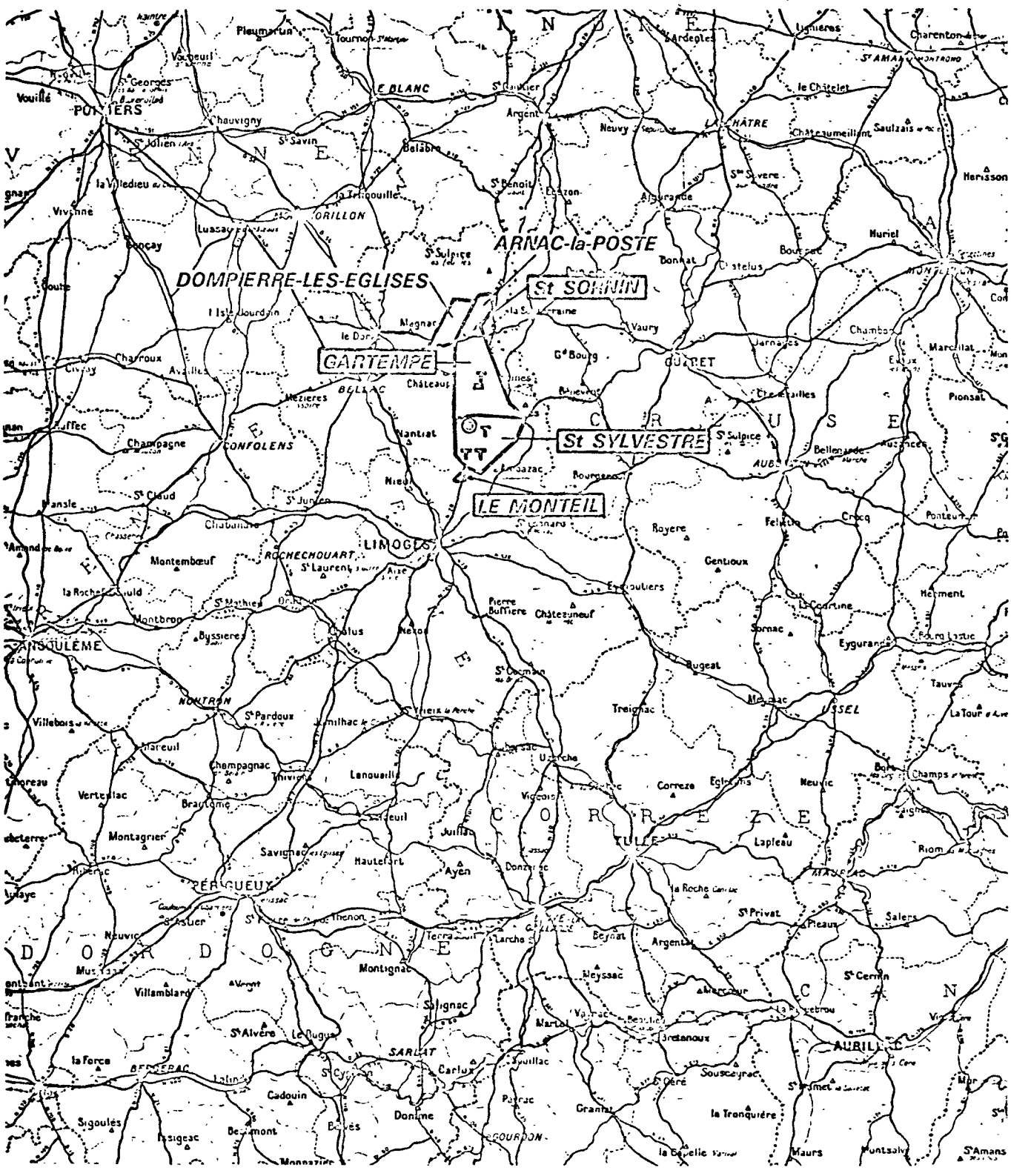
Usine de traitement des minerais

Siège de la division

Principaux chantiers

DOMPIERRE-les-EGLISES Permis de recherches

LE MONTEIL Concession - Permis d'exploitation



DIVISION DE VENDEE

ECHELLE :1/1.000.000

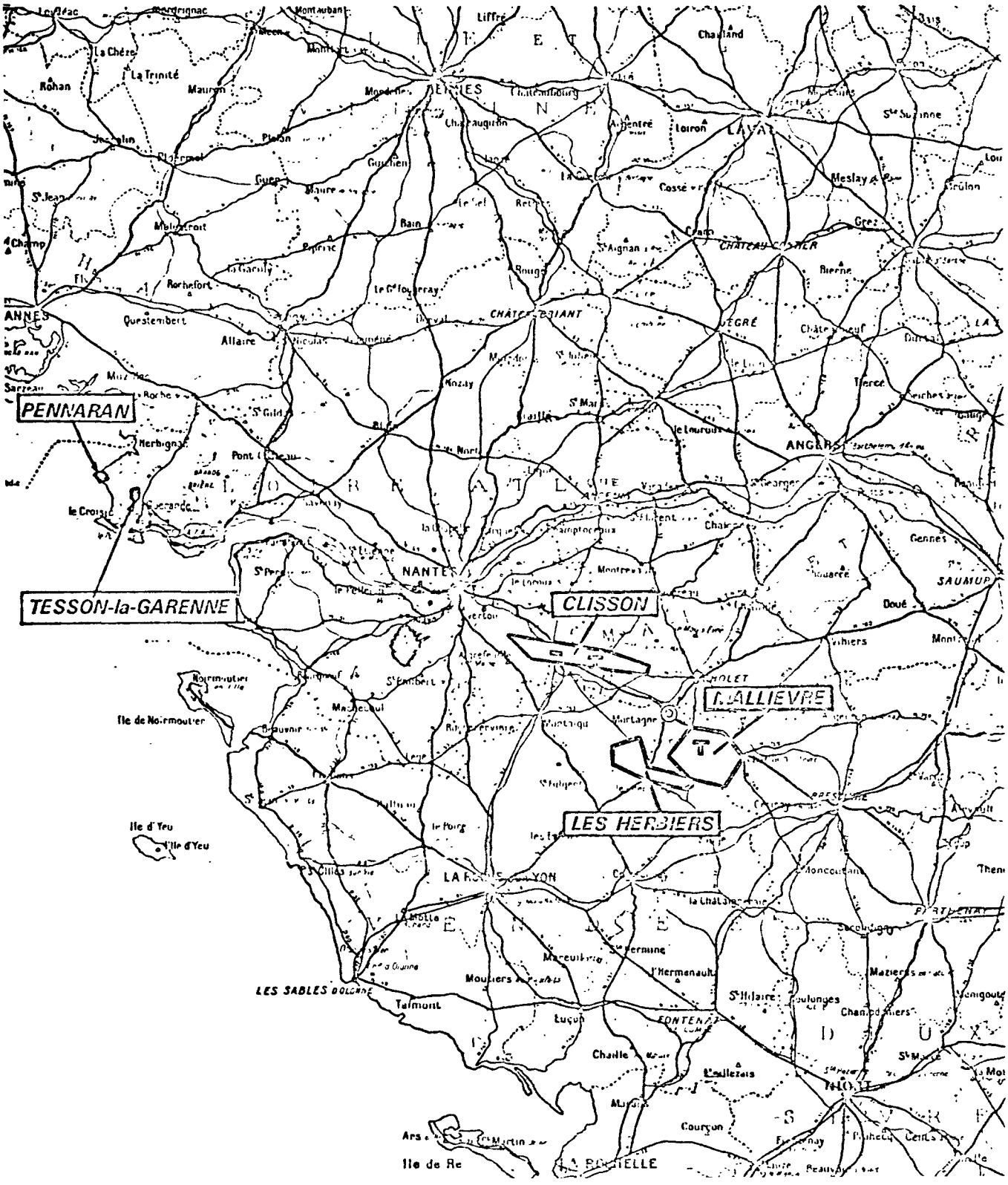
Usine de traitement des minerais

Siège de la division

Principaux chantiers

Permis de recherches

CLISSON — Concession - Permis d'exploitation



DIVISION DU FOREZ

ECHELLE :1/1.000.000

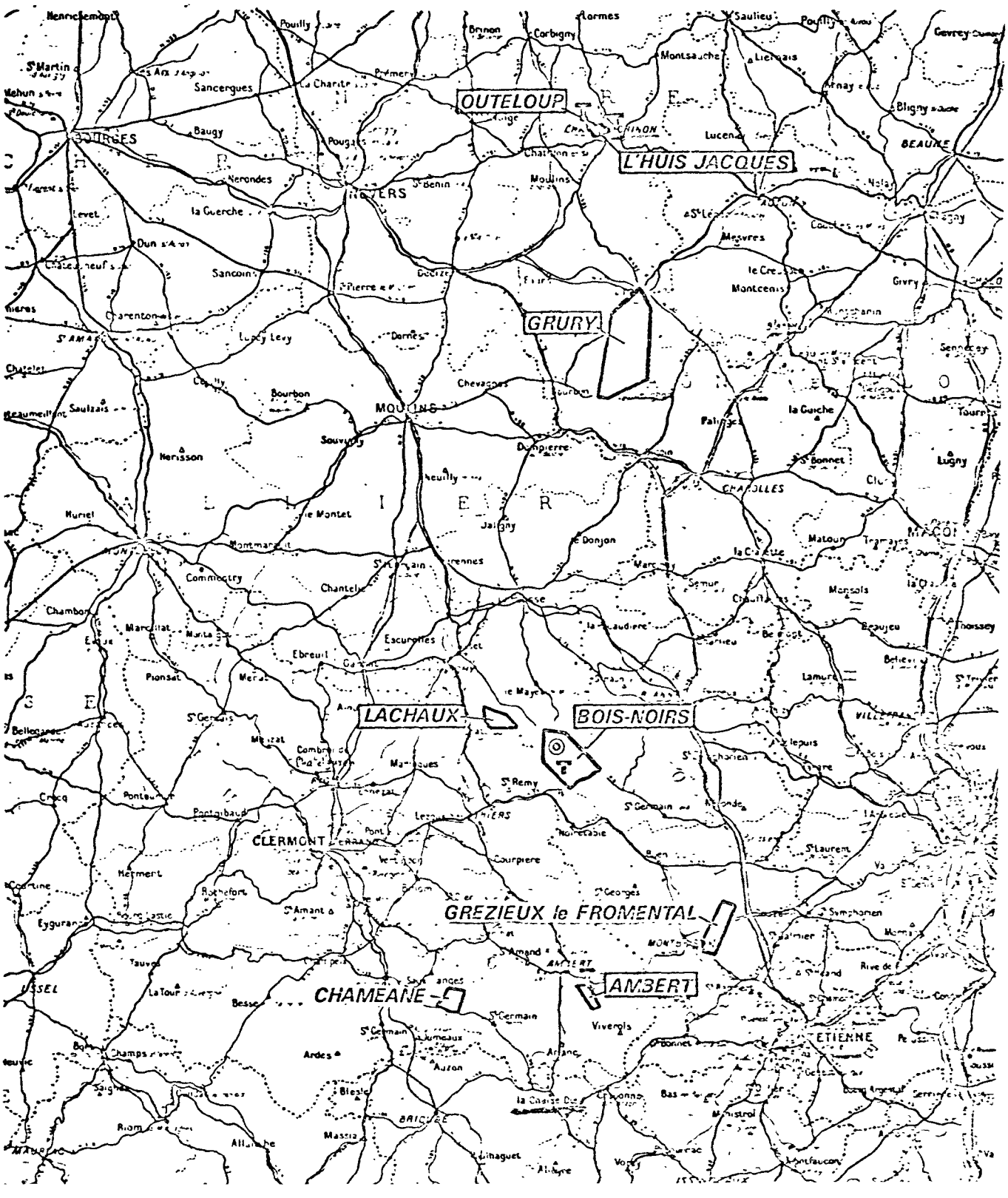
Usine de traitement des minerais

Siège de la division

Principaux chantiers

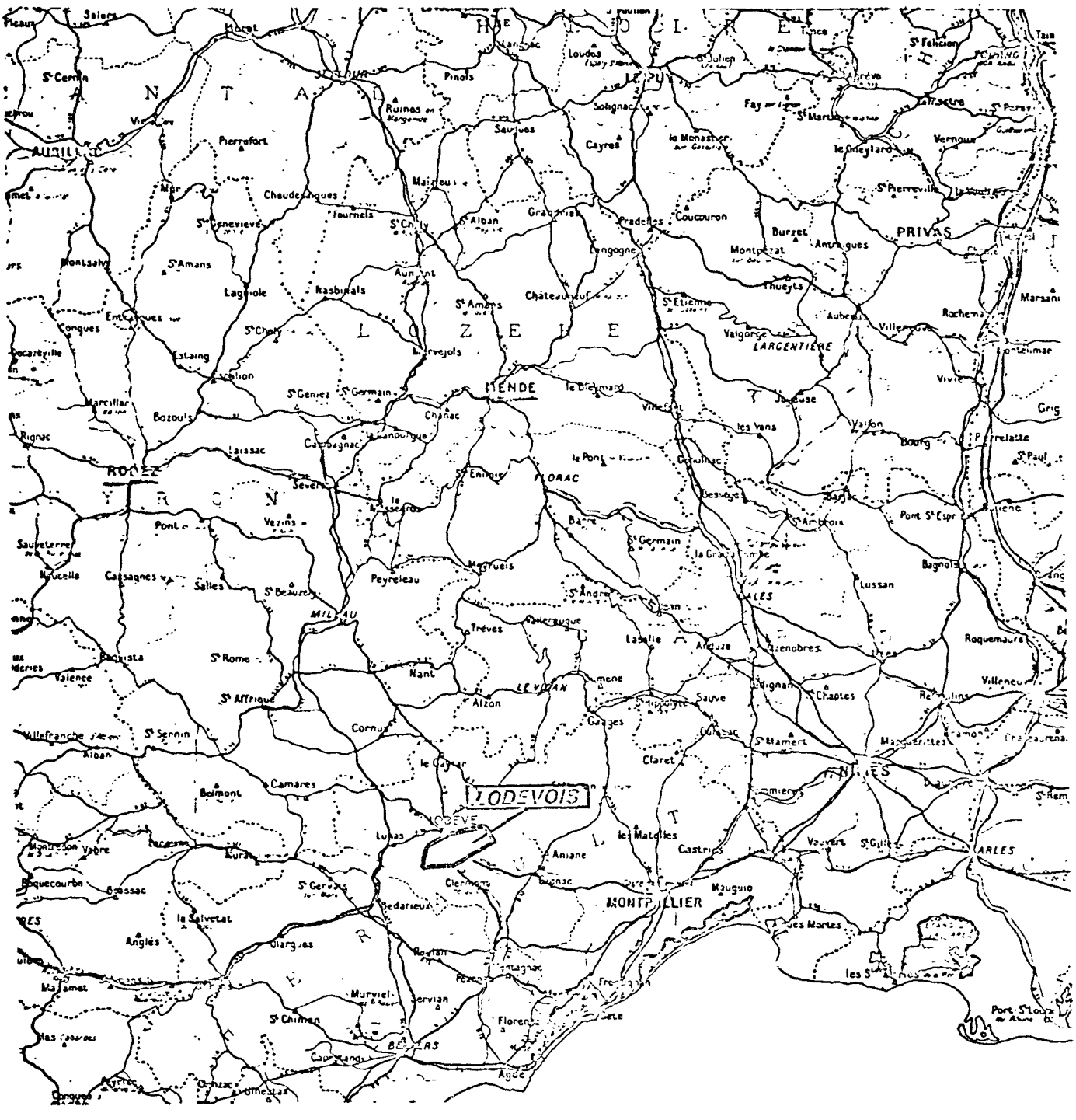
CHAMEANE Permis de recherches

AMBERT Concession - Permis d'exploitation



MISSION DE L'HERAULT

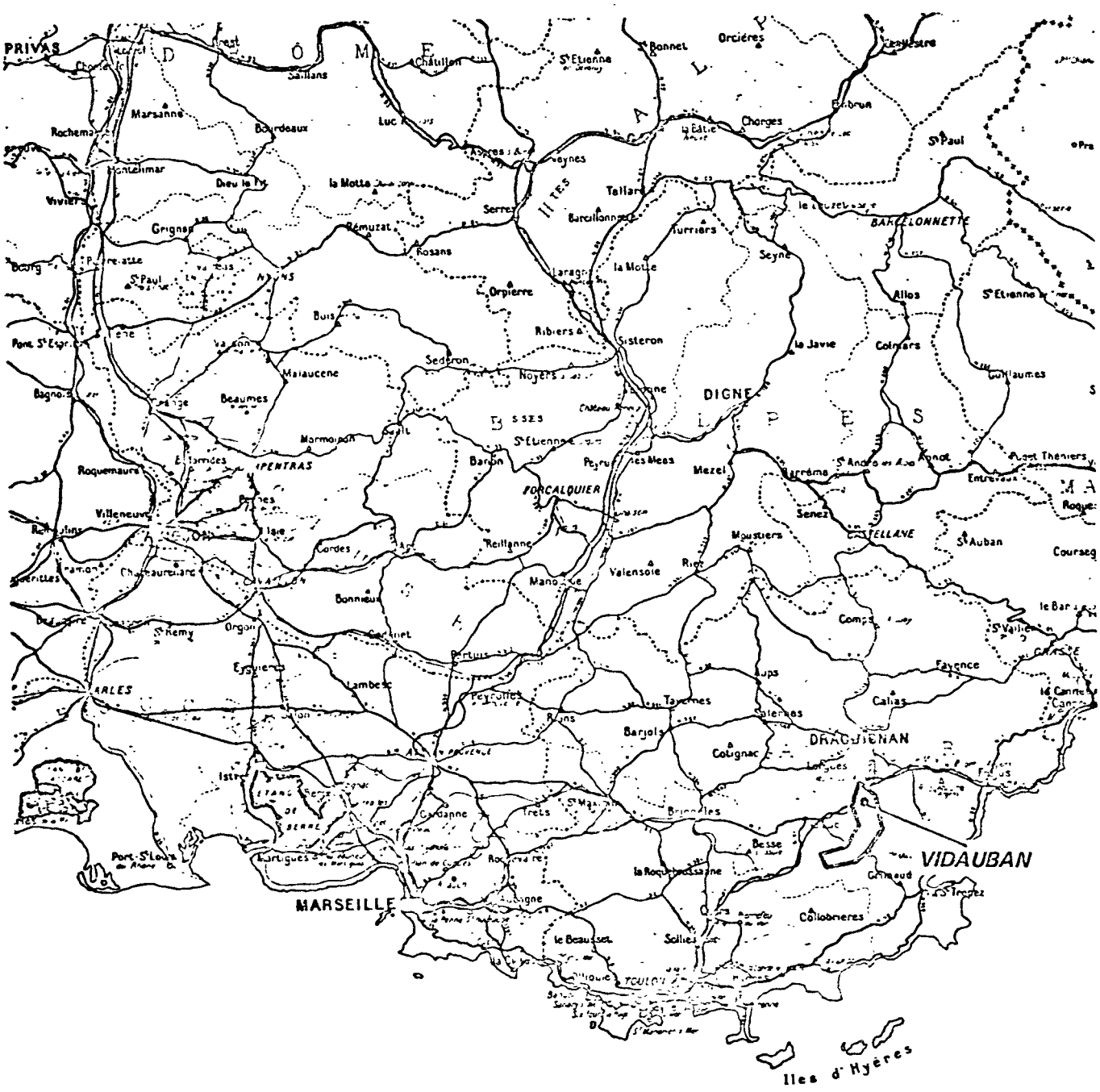
ECHELLE :1/1.000.000



CONCESSION DU LODEVOIS

MISSION DU VAR

ECHELLE :1/1.000.000



PERMIS DE RECHERCHES

XVII-231-74-Irl.

IRELAND

Annual Report under Article 70 of the Euratom Treaty on the development of prospecting and production, probable reserves and investment in mining

There are no known deposits in Ireland of radio-active minerals approaching anything like a workable grade. In consequence there are no ore processing plants.

Prospecting has been carried out by the Geological Survey on all or nearly all potential locations such as those of mineral deposits, pegmatites, conglomerates, etc., the instruments used being a geiger counter type ratemeter and a scintillometer, both hand-held instruments. A considerable amount of non-systematic prospecting has also been done by private interests notably by the large number of companies prospecting for base metals. The instrumentation included hand-held, truck mounted and airborne equipment, the aerial surveys being over limited areas and coincidental with electro-magnetic and magnetic surveys. Radio-metric logging of deep boreholes has also been done.

Currently there are no formal programmes of prospecting for radio-active minerals but the Geological Survey regularly checks any new material of potential interest and presumably the prospecting companies do likewise.

To date no deposits approaching workable grade have been identified. No reserves have been established and there is no production.

Report on the development of prospecting for radioactive minerals in Italy up to 1972

Prospecting for uranium was begun in Italy in 1950 by a few private companies (including Montecatini and La Société Minière et Chimique pour l'Uranium). In this first phase the main work was carried out in the period 1958-60 and yielded fairly interesting results.

It was not until 1967, when prospecting was resumed on a world-scale, that work began under the auspices of the CNEN and SOMIREN (of the ENI Group), the national agencies operating in this sector, to confirm, and in some cases, to evaluate these mineral reserves with the aid of modern techniques.

The principal uranium bearing areas located on national territory are shown on the appended map. Areas which are of definite and effective mining interest, containing particular types of uranium deposits, distinguished by the form and the distribution of the deposits according to the origin and concentration of the ore, are as follows:

(a) Novazza, in the Lombard Alps where the uranium mineralizations are associated with acid tuffaceous rocks, interspersed in a carboniferous series of volcanic origin (Collio series).

The ore is composed of pitchblende, normally accompanied by blende, sericite and quartz (average concentration 0.146% of U_3O_8.

Eight ore masses, of lenticular shape and varying dimensions, have been located. Their course is the same as that of the ebonites in which they are incorporated.

(b) Val Rendena (south-west Trentino), whose uranium bearing deposits, of sedimentary origin, are situated around the massif of Adamello.

The uranium ore is always contained in the formation of Permian sandstones, in the form of a mass, lens or small stratum located along the strata proper (average concentration of the ore hardly exceeds 0.1% of U_3O_8).

(c) Northern Latium (Viterbo) where quaternary ebonites dominate and where the radioactive mineralization corresponds, for the most part, to strata of infusorial earth and tuffs mineralized with marcasite. Mineralization is mixed: uranium and thorium. Even though the average concentration of U_3O_8 hardly exceeds 0.05% the fairly superficial location of the mineralized masses and the fact that the uranium is included in argillaceous tuffs constitute ideal conditions for open-cast mining, which would reduce costs.

Methods used for prospecting

The choice of prospecting techniques was mainly determined by technical and geomorphological factors. It must be remembered that, in Italy, the most interesting zones are located in mountainous regions mostly inaccessible by road, which makes the use of certain prospecting methods impossible.

According to the most recent data, prospecting was carried out with: airborne radiometric equipment over 4 900 km^2
portable " " " 1 400 "
vehicle mounted " " " 40 000 "
geochemical methods over 50 000 "

The total area prospected for uranium in Italy amounted to about 75 000 km^2. Certain areas were prospected several times using different methods.

Geochemical methods, which were used instead of radiometric methods for large-meshed regional surveys, were also used in the less

promising geological areas.

In all, it may be said that most of the favourable formations have been prospected, 75 000 km^2 by large-meshed surveys, 15 000 km^2 more closely and 2000 km^2 very finely.

Only a few areas in Sardinia need to be reconsidered.

Results of prospecting

During the 50's the company Montecatini and the Société Minière et Chimique pour l'Uranium began by driving a few hundred metres of roadway through uranium mineralizations in the Maritime Alps and produced a limited amount of concentrates.

In their turn, the CNEN and SOMIREN (of the IRI Group) worked to confirm the mining interest of areas which had been identified in the meantime. Whereas the areas offering no industrial interest were abandoned, prospecting was continued in more promising areas until the extent of their deposits was fully known.

To sum up, prospecting has been carried out so far in a number of places in the Alps, between the Maritime Alps and Carnia, in Northern Latium, on the Silla (Calabria) and on the Sarrabus (Sardinia). The work has been mainly concentrated in three uranium bearing areas of major interest: Novazza, Val Rendena and the region of Viterbo.

A total of about 15 000 m of roadway has been driven, almost all of it by the firm SOMIREN. Of this total, 4000 m were driven in the area of Val Redena, more than 5000 m in Novazza and about 4000 m in various parts of the western and Maritime Alps.

In addition, about 19 000 m of drillings have been made, 10 000 of them in the Novazza zone by the firm SOMIREN (of which 9000 m were drilled from roadways where the core samples were partially recovered) and 9000 m by the firm CNEN mostly in the region of Viterbo.

Definite results obtained at the end of 1972, considering only the category of reasonably certain reserves which can be exploited at a cost of less than $ 10 per lb of U_3O_8, amount to 1500 short tons U_3O_8 (1 360 metric tons of U_3O_8 corresponding to 1 154 metric tons of uranium).

Ninety percent of these reserves are contained in the deposit of Novazza. Other mineralizations representing a few dozen short tons of U_3O_8 have been confirmed in Val Rendena and in the Cozie Alps (Preit).

Probable reserves can be estimated at 10 000 short tons of U_3O_8 (9 070 metric tons of U_3O_8 corresponding to 7 690 metric tons of uranium) at prices ranging between $ 10 and $ 15 per lb of U_3O_8 and 20 000 short tons of U_3O_8 (18 140 metric tons of U_3O_8 corresponding to 15 380 metric tons of uranium) at prices exceeding $ 15 per lb of U_3O_8.

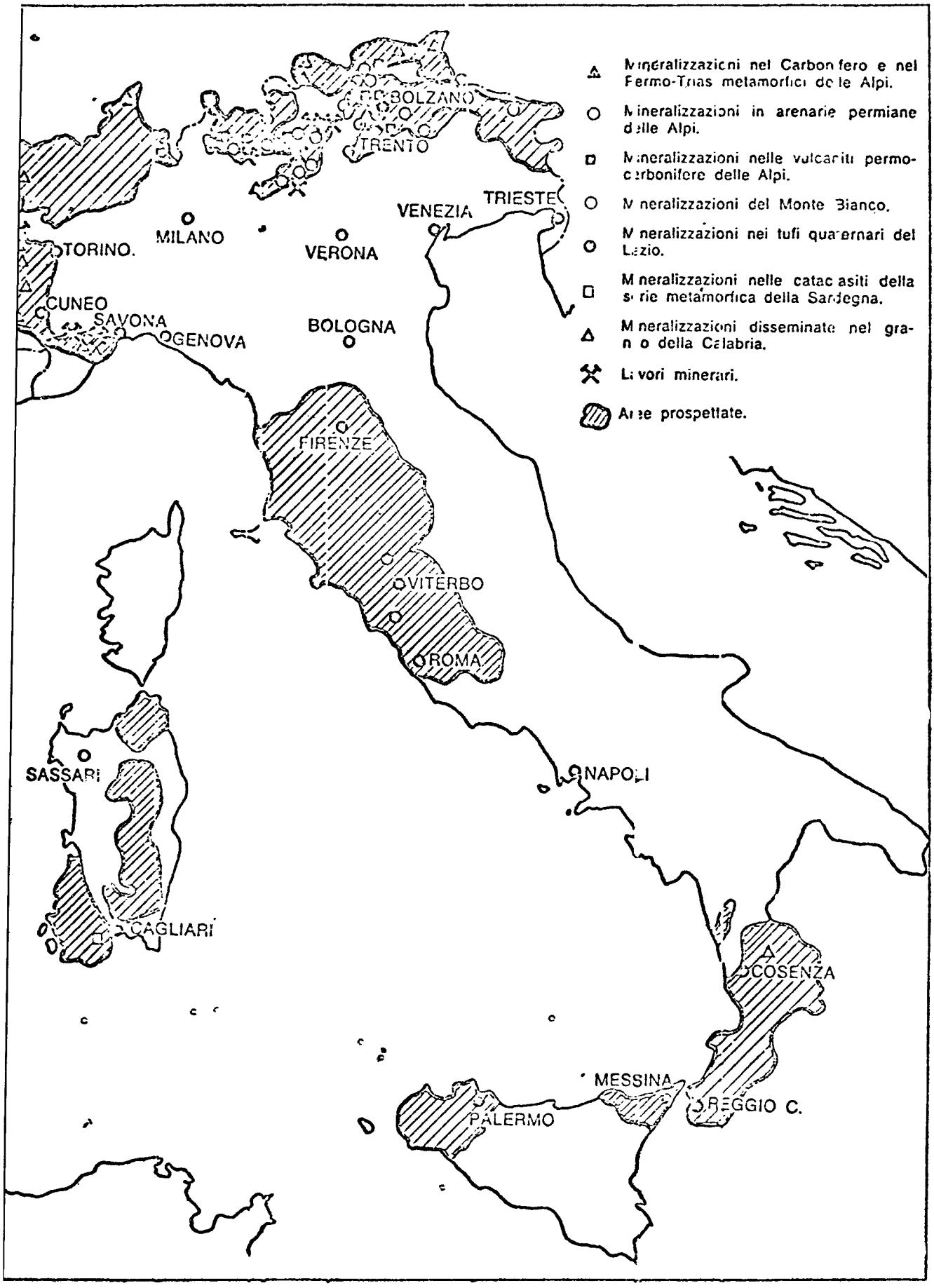
This category of reserves is largely located in the poor mineralizations of Norther Latium, still being explored.

Investment in mining

During 1972 in the six uranium ore prospecting concessions in the mining district of Bergama (Groma, Cima di Bani, Gandellino, Pagherola, Roccolo and Lago Nero), underground prospecting carried out by SOMIREN involved the driving of 1 0 20 m of roadway and the drilling of 4 350 m of boreholes.

Investment amounted to a total of 350 million lire (560 000 u.a.)
For 1973 it is planned to invest about 500 million lire (800 000 u.a.).

In the four concessions being prospected in the mining district of Rome (Macchia Grande, Legarelle, La Carbonara and Pontane) investment in prospecting amounted to about 100 million lire (160 000 u.a.).



Rappresentazione schematica delle aree prospettate fino al 1972.

XVII/231/74-E

Office of the Permanent Representative
of the Grand Duchy of Luxembourg
to the European Communities

Brussels, 4 July 1973

Sir,

With reference to your letter of 13 March 1973 (Ref. 73/535) concerning the report on the development of prospecting and production, on probable reserves and on investment in mining, I wish to inform you that no prospecting for uranium or thorium took place in the Grand Duchy of Luxembourg in 1972.

Yours faithfully,

For the Permanent Representative

E. Ruppert
Attaché

Mr Fernand Spaak
Director-General for Energy and Safeguards
Commission of the European Communities
rue de la Loi, 200
1040 Brussels.

XVII/231/74-E

Office of the Permanent Representative
of the Netherlands to the European
Communities

Brussels, 30 March 1973

Prospecting and production of mineral substances

With reference to your letter of 13 March 1973 (Ref. 73/00536), I wish to inform you that no prospecting for or discovery of uranium or thorium has taken place in the Netherlands.

The Permanent Representative

P.C. Nieman

Commission of the European Communities
Directorate-General for Energy and
Euratom Safeguards

rue de la Loi, 200
1040 Brussels.

INFORMATION REPORT ON URANIUM IN THE UNITED KINGDOM.
EURATOM TREATY ARTICLE 70: REPORT ON MINERAL DEPOSITS AND MINING INVESTMENT.

INTRODUCTION

The institute of Geological Sciences (IGS), Geochemical Division, on behalf of the United Kingdom Atomic Energy Authority, undertook a programme of reconnaissance for uranium in the five-year period April 1968 to March 1973. The objective was an assessment of uranium potential in terms of the modern trend to the exploitation of low-grade, large-tonnage deposits. Previously, particularly in the periods 1945-51 and 1957-60, largely ad hoc investigations had been conducted in regions of known uranium deposits, principally of vein type and the new programme provided the opportunity to examine environments selected on other, more fundamental geological/geochemical criteria. Th method of selection was discussed by Ostle, 1970, in a paper which identified the favourable areas, and the accompanying map is taken from that paper.

The reconnaissance by the IGS ended in March of this year and official participation in uranium prospecting and exploration is now limited to the analysis of geochemical samples collected for other purposes and to radio-metric observations (employing portable ratemeters) taken in the course of regional geochemical sampling. The extent of current commercial mining company interests and activities is not precisely known. Future annual reports are likely to deal only with particular investigations and any company information which is released and this information report therefore represents a brief summary of all the five-year reconnaissance activities and includes resumés of the geology of those areas initially considered to be favourable to the occurrence of uranium deposits, of the reconnaissance and follow-up methods employed and of the results. Mention of earlier work is included under appropriate regional heads.

In addition to publications relating to uranium in the UK and to the reconnaissance, the IGS announced in 1971 that a series of detailed reports on the northern Scotland region was available to persons or organizations wishing to undertake further exploration and assessment work. These are listed in the Bibliography.

2. LOCATION OF DEPOSITS, PROSPECTED ZONES AND ORE-PROCESSING PLANTS

No deposits have yet been proved to be of ore grade in the UK and no uranium mines or processing plants are therefore in operation. The accompanying map indicates the locations of types of uranium occurrences as they were known in 1968, prior to the IGS reconnaissance. They include:

(i) Polymetallic vein deposits in the southwest of England mining region (the map identifies those for which age determinations carried out on the primary uranium minerals, pitchblende and coffinite, are available);

(ii) polymetallic veins at Laxey, Dalbeattie, Tyndrum and Helmsdale;

(iii) anomalous enrichments of uranium in black, Cambro-Ordovician shale in north Wales;

(iv) anomalous uranium enrichments in phosphatic limestone in the Carboniferous Limestone of the Pennines;

(v) anamolous uranium values in Namurian shales in south-west England and flanking the Derbyshire Dome.

As a result of the recent reconnaissance, the extent and number of deposit types in northern Scotland can be considerably increased, as also can the number, and possibly the type, of concentrations in south-west England.

3. SUMMARY DESCRIPTION OF GEOLOGICAL CONDITIONS AND DEPOSIT TYPES

(a) Northern Scotland

(1) Eastern part of the Northern Highlands of Scotland and the Orkney Islands.

This area lies within the metamorphic belt of the Caledonian orogen. The basement is composed largely of the late Pre-Cambrian Moinian assemblage which consists of quartzitic, arenaceous and argillaceous sediments deposited on the Archaean Lewisian gneiss complex now seen as fold cores and thrust slices in the west of the region. Polyphase metamorphism and migmatization have produced an extensive migmatite complex and this is intruded by late Silurian granites and syenites. Post-orogenic Devonian sediments rest with pronounced unconformity on the basement and comprise a fluviatile and lacustine cyclic sequence ranging from course red-bed conglomerates to black calcareous mudstones.

Minor tuffaceous sediments and lava flows are present within the sequence. Later sediments from Permian to Jurassic are exposed to the east of a major coastal fault in a narrow strip bordering the Moray Firth basin.

In this region the reconnaissance led to the discovery of numerous new uranium occurrences in a variety of modes, as follows:

(i) A high incidence of uranium occurrences in the lower members of the Middle Old Red Sandstone of northwest Caithness, west of a regional fault line in central Caithness and on Mainland Orkney. In many cases, uranium concentration is related to high phosphate content of the rocks and is interpreted as being penecontemporaneous with deposition of the sediments.

(ii) Small-scale concentrations of uranium associated with minor tectonic features in the uraniferous sediments.

(iii) Uranium in narrow shears in the Helmsdale granite and anomalous radio-activity associated with zones of alteration in the granite.

(iv) The unusual concentration of uranium, in the form of fine-grained uraninite and of secondary minerals, in a basal arkosic member of the Old Red Sandstone succession immediately overlying the Helmsdale granite, at Ousdale on the southeast coast of Caithness. Uranium occurrences and radioactive anomalies are known in at least one zone exceeding a kilometre in length. Mineralization controls have not been established beyond question, the area being faulted while the uranium distribution appears to be principally, but not wholly, stratiform.

(b) Southern Uplands of Scotland

This area lies within the non-metamorphic belt of the Caledonian orogen. Highly deformed Ordovician and Silurian geosynclinal strata trend NE-SW parallel to the Southern Uplands fault which forms the northern margin to the area except in the west. There, immediately north of the fault, Ordovician sedimentary and igneous relationships suggest the site of a subduction zone. Late Silurian to lower Devonian granites intrude these rocks at high level and there are associated lava flows with the Cheviot mass in the east. The major post-orogenic unconformity is of the Devonian but the southern margin of the area is defined by the Carboniferous unconformity. Faulted outliers of Carboniferous to Permian strata occur in basins across the region.

Uranium mineralization, in the form of uraninite and associated with bismuth, had been discovered in the region on the Solway coast near Dalbeattie. Thin steeply inclined siliceous veins occur normal to the southern margin of a granodiorite mass within the hornfelsed sediments flanking it. The mineralization is locally of high grade but commercial tonnages are not available. The possible role in mineralization control of a major crush zone parallel to the granite, and of the nearby Carboniferous unconformity, has not adequately been tested as the existing evidence does not recommend the costly exploration involved. A similar minor vein occurrence of uraninite was discovered in the course of the recent reconnaissance near the northwest margin of the same granite.

(c) Midlands of England

The objectives of the reconnaissance in this region were the identification of sources for anomalous uranium values in the ground water boreholes intersecting Triassic sediments. The Trias in this area rests uncomformably on the Permian or Coal Measures and comprises arenaceous beds and marls probably laid down on a desert plain of great extent supporting shallow salt lakes. The beds were deposited between the Cambrian Mountains and the Mercian Highlands.

(d) Black shales of England and Wales

Marine black shales in the Carboniferous have previously been shown to contain anomalous concentrations of uranium in certain horizons, mostly in the Namurian. The possibility of there being large tonnages of low grade uranium ore in these rocks was investigated in the areas neighbouring the Derbyshire Dome and surrounding the N Wales, S Wales and the Forest of Dean Coalfields.

Anomalous concentrations of uranium were confirmed and in the Derbyshire area were located where the basal Namurian lies with sharp disconformity on the underlying limestone. Where a gradual transition occurs from the Carboniferous limestone through calcareous shales or interbedded limestone and shales, high values of radioactivity are absent. No significantly high values of radioactivity were detected in the Namurian surrounding the N Wales and Forest of Dean Coalfield.

In South Wales, isolated exposures in the Millstone Grit Series show higher than average values of uranium and one marine band especially (the Reticulocerus inconstans marine band), exhibits anomalous activity along the northern outcrop and on the one locality where it outcrops in the south of the coalfield.

Uranium was already known to occur in N Wales in subeconomic amounts in the upper Cambrian "Black Band" which outcrops in the English Borderland.

Moderately high levels of radioactivity occur in the Lower Rhyolite Tuffs and in a sequence of autobrecciated rhyolite near Beddgelert. Multielement analysis of the stream sediments collected resulted in some areas of possible base metal enrichment being delineated.

(c) South West England

The geology of the south west England metalliferous mining region comprises a series of geosynclinal sediments the earliest of which are grits, sandstones and conglomerates of Lower Devonian age succeeded by Middle and Upper Devonian slates and mudstones containing calcareous and volcanic members. Carboniferous grits, black shales, slates and grey shales, with intercalated volcanic beds, occupy the northern part of the area. Structure is complex, with recumbent folding of the sediments. The latter are intruded by an early suite of basic rocks, now diabase, which take a variety of forms but the main episode of igneous activity resulted in the emplacement of several stocks of leucocratic granite representing the shallowest parts of a granite batholith which underlies much of the peninsula, plunging steeply on the northern margin. Dykes of porphyry, small pegmatites and bodies of greisen comprise the next stage of igneous activity which finally leads to the deposition of metalliferous lode deposits. The latter are largely associated spatially with the granite stocks and the thermal aureoles surrounding them and they exhibit metal zoning from tin through tungsten, copper, lead and silver.

Uranium has long been known in association with many of the lodes and the ore has been exploited on a small scale in the past. It occurs as pitchblende, uraninite, coffinite and their secondary derivatives in association both with tin and copper lodes, age determinations indicating several ages of mineralization, even in the same vein structure. Some minor enrichment of uranium occurs in grey shales of Namurian age north of and remote from the large Dartmoor granite mass and anomalous uranium concentrations are associated with disseminated pyrrhotite marginal to the same granite.

The lode uranium mineralization is locally of high grade but of sporadic distribution, the largest shoots discovered to date probably containing no more than a few tens of tons of U_3O_8, with one in the several hundred ton size range.

4. PROSPECTING SITUATION BY REGION

(a) Northern Scotland

The main obstacle to the detection and assessment of uranium occurrences in this region is the very extensive covering of superficial deposits comprising glacial drift and peat. Over large areas standard radiometric surveys have therefore little application although they are effective along stream courses and coastal sections. A multiple-technique approach was therefore made to the reconnaissance and assessment stages, involving the following stages, not always sequential:

1. Regional geochemical drainage surveys employing stream sediment and water samples, rapid analysis being carried out by the delayed neutron activation method.
2. Vehicle-mounted radiometric traversing of roads and tracks, providing only limited coverage.
3. On-foot radiometric traversing on exposed sections, based on geological interpretations of favourability.
4. Helicopter-borne survey of inaccessible, extensive coastal cliff sections employing a sideways-looking scintillometer.
5. Gamma monitoring of shallow auger holes through peat in the follow-up stage.
6. Portable gamma spectrometer examination of anomalies.
7. Radon in soil surveys for the precise delimitation and the extension of anomalies, employing in situ measurements by proves developed for emanometry by the IGS and UKAEA.
8. Geochemical soil sampling.
9. Shallow scout drilling of anomalies.
10. Deeper drilling (coring and non-coring) of very limited extent on two occurrences.

New discoveries were effected by vehicle-mounted and on-foot radiometric methods and as a result of the follow-up of hydrogeochemical anomalies. The latter, even at low-density sampling intervals, was particularly effective as a primary method of indicating areas of high favourability. Comparison of uranium distribution in stream sediments and surface water was shown to provide a means of distinguishing leachable uranium from that held in refractory mineral phases.

Of particular value at the follow-up or assessment stage of investigations in this region was the application of a modified, small diameter total gamma probe (5. above) to the study of uranium distribution beneath peat cover. The tracing of boulder trains by this means led to the precise location of bedrock mineralization.

(b) South West Scotland

In view of the very large and locally difficult areas to be covered, greatest reliance in this region was placed on geochemical drainage sampling, augmented be vehicle-mounted reconnaissance and extensive foot surveys of selected geological targets such as major unconformities, granite margins and the Cheviot igneous complex. The standard geochemical procedure employed stream sediment samples but effective use was also made of apnned concentrates, which provided much useful data on the occurrence of other metals. In the Jedburgh basin of flat-lying Old Red Sandstone sediments recourse was made to the analysis of ground water from numerous boreholes penetrating the sandstones.

(c) Midlands of England

Ground and surface water sampling was the principal technique employed on investigations of the flat-lying Triassic formations, augmented by vehicle-mounted traverses which became the primary techniques over the older rocks flanking the Triassic basin. Anomalies were investigated with the assistance of soil sampling and radon-in-soil air surveys.

(d) Black Shales

Investigations aimed at the discovery of large areas underlain by uraniferous shales were based mainly on the study of exposed or thinly covered sections of bedrock, employing light-weight but high-resolution scintillation ratemeters. A large area in North Wales, however, was surveyed by means of stream sediment and water sampling because of the favourable hydrogeochemistry and the variety of geology.

(e) South West England

The full range of available techniques was applied in this region, local emphasis depending on geology and assessments of the most likely mode of mineralization to be expected. Experience indicated that geochemical drainage sampling (neither stream sediment nor water) was effective in discovering the uranium concentrations typical of the bulk of the region and almost complete recourse was eventually made to vehicle-mounted and on-foot radiometry as the most successful techniques. Follow-up investigations made use of geochemical soil sampling employing a mechanical auger, radon-in-soil air surveys, radiometric gridding, and shallow drilling. In the 1957-58 period of operations a combined magnetic/radiometric airborne survey had been carried out over this region at a ground clearance of 500 ft and a line spacing of 0.4 km. Follow-up of about 450 anomalies led to the identification of many new uranium occurrences but the recent reconnaissance showed that by no means all significant surface anomalies were detected from the air.

5. EXPENDITURE

Total expenditure on the field operations over the five-year period was £250,000 sterling, which included the costs of operating a lightweight diamond drilling machine and mechanical auger. A detailed breakdown of expenditure, either by region or techniques, is not yet available, but expenditure in northern Scotland substantially exceeded that in other areas.

6. RESULTS OF THE SURVEY AND RESERVE ESTIMATES

The discovery of widespread but low-grade uranium enrichments in northern Scotland established this region as a small but discrete uranium province or sub-province. As stated earlier, much of the uranium is concentrated in thin phosphatic horizons but local enrichments tested to shallow depth in arenaceous sediments and discordant structures probably represent resources of a few thousand tons of U_3O_8, of probably sub-economic grade.

The re-examination of the south-west England region led to the discovery of uranium concentrations associated with recently identified zones of wrench faulting in proximity to Hercynian granites. The new occurrences have not been tested and confident resource estimates cannot be made. Uranium values

are locally high and some zones show evidence of continuity sufficient to indicate resources of the order of hundreds of tons of U_3O_8.

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- - - APPROXIMATE AREA BOUNDARIES.
o Uranium localities,
(230) U age in m.y.
NORTHERN SCOTLAND
Castletown
Helmsdale
Chiapival (1565)
Tyndrum (230)
SOUTHERN UPLANDS
Dalbeattie (185)
Rookhope
Laxey
Namurian
Derbyshire Phosphates
MIDLANDS
Cambro-Ordovician shales
Wheal Bray (165)
Dampton shales
South Crofty (277)
King's Wood (206)
Geevor (290:223 45)
South Terras (47)
S.W. ENGLAND