AGE AND DISTRIBUTION OF PEGMATITES

KENNETH K. LANDES, University of Kansas.

AGE

INTRODUCTION

Pegmatites have been formed during periods of intrusive igneous activity from the pre-Cambrian to the present. A detailed age classification of such deposits is impossible of compilation at present. Most pegmatites occur in regions of crystalline rock where age determinations from field observations are usually approximations at best. However, important progress has been made during the last decade in determining the age of pegmatites and other mineral bodies containing radioactive minerals by determining the ratios between lead and uranium and thorium. Analyses have shown that the pegmatites in the great pre-Cambrian shield areas, many of which are undatable from geological evidence, are themselves pre-Cambrian in age. Most of the analytical work to date in rocks younger than the pre-Cambrian has been for the purpose of building up a time scale through obtaining specimens from rock bodies which were already fairly well placed in the geologic column by field observations. In the future more use can be made of this method to determine the age of pegmatites and other radioactive mineral-bearing deposits which are impossible of dating by field observation. This has already been done by Foye in New England.

THE PRE-CAMBRIAN PEGMATITES

Pegmatites are abundant in the pre-Cambrian areas of the Laurentian Shield of northeastern North America, the Fennoscandian Shield in northwestern Europe (including Scotland), and in the Gondwanaland belt of South America, Africa, India, and Australia. In addition many smaller areas of pre-Cambrian rock

1 The writer gratefully acknowledges helpful criticism given during the preparation of this chapter by A. C. Lane and J. P. Marble.
contain pegmatites. Examples of the latter in North America are the belt of pre-Cambrian rocks in the Appalachian Mountain region, a large number of districts in the Rocky Mountain area, and the inner gorge of the Grand Canyon of Arizona.

Simple pegmatites (those in which no hydrothermal replacement has taken place) are extremely common in the pre-Cambrian terrane. Many of these are of the lit-par-lit type. Some of the simple pegmatites are sufficiently large to be exploitable for feldspar or mica or other minerals. Complex pegmatites were also formed during pre-Cambrian time. Examples are the lithium pegmatites of Western Australia and the Rocky Mountain belt (including the Black Hills) of North America; the rare earth pegmatites of Llano County (Texas), Minas Geraes (Brazil), Ytterby (Sweden), Tanganyika, and India; and the beryl pegmatites of Brazil and South Africa.

**PALEOZOIC PEGMATITES**

Pegmatites of Paleozoic age are found wherever the Paleozoic era was marked by intrusive igneous activity. One of the best regions illustrating this is New England and the Paleozoic Appalachians to the southwest. According to Bastin, the granites of Maine were intruded in Late Silurian or Devonian time, and the pegmatites are also probably of that age. The Strickland pegmatite at Portland, Connecticut, the near-by Hale deposit (Glastonbury), and the Blueberry Mountain pegmatite at Woburn, Massachusetts, are Devonian in age. The famous Bedford pegmatite in Westchester County, New York, intrudes the Ordovician Hudson schist. The ages of both this and the Branchville, Connecticut, phosphate pegmatite have been determined by the lead-uranium ratio to be 380 million years, which corresponds to the Late Ordovician (Taconic revolution).

---


7 Lane, Alfred C., Rept. of the Committee on the Measurement of Geological Time: *Nat. Research Council*, pp. 11-13, 1933.

contain pegmatites both in the pre-Cambrian and in the Late Paleozoic. Many of the pegmatites in the New England-Appalachian belt are complex, exhibiting lithium, boron, phosphate and other phases. Paleozoic alkaline syenite pegmatites occur on Mount Royal, Montreal.

Intrusions of pegmatite accompanied Paleozoic ore deposition in widely scattered parts of the globe. Tungsten-bearing pegmatites in England are post-Silurian in age. Both tin and tungsten minerals occur in pegmatitic quartz veins accompanying the Paleozoic granites of western Spain. Tin-bearing pegmatite dikes in eastern Victoria cut the Silurian metamorphic series. Pegmatites associated with the ore deposits of the New England area of New South Wales are related to Carboniferous and Perm-Carboniferous granite. Ore-bearing pegmatites accompany Devonian granite in northern Tasmania. A Paleozoic age is assigned by Holmes to the rare earth pegmatites of Langesundfjord, Southern Norway, and Miask, Urals.

**MESOZOIC PEGMATITES**

The great batholiths which were intruded in the latter part of the Mesozoic in the Cordilleran region of western North America were accompanied by pegmatites. Granitic pegmatites occurring in British Columbia are referred to the Lower Cretaceous. Peg-

---


16 Dolmage, Victor, Finlay River district, British Columbia: *Canadian Min.*
matites, some of them complex, accompanied the intrusion of the Idaho batholith. The age of this batholith is variously estimated as end of Jurassic, late Cretaceous, and early Eocene. The country rock into which these pegmatites are intruded is pre-Cambrian at several localities. Pegmatites likewise accompany the Mesozoic batholiths of Oregon, Montana, Nevada, and California. A number of the minerals found at Crestmore, California, were formed through the action of pre-Cretaceous pegmatite dikes on Paleozoic (?) limestone. The pegmatites of San Diego, California, world famous for their tourmaline crystals and lithium minerals, are of Mesozoic age, probably Jurassic. Albite and diabase pegmatites of Triassic age occur in Virginia and pyrite-bearing pegmatites occur in the Triassic diabase of the Palisades. Pegmatite dikes which are probably related to post-Permian granitic intrusions occur in the Vosges region of France. A pegmatitic ore deposit in Austria, of pre-middle Cretaceous age, has been described by Friedrich.


23 Daly, John W., Paragenesis of mineral assemblage at Crestmore: (Abstract) Pan-American Geologist, pp. 312-313, May, 1933.

24 Engel, René, Personal communication, dated April 18, 1934.


28 Friedrich, O., Eine alte, pegmatitische Erzlagerstätte der Ostalpen: Neues
pegmatites occurring in the granite of Ishikawa in the Province of Iwaki in Japan are referred to the Mesozoic, probably Jurassic.\textsuperscript{29}

**Cenozoic Pegmatites**

The area of outcrop of Cenozoic intrusive rocks is relatively small so pegmatites are not abundant. Undoubtedly the number will increase in the geologic future as erosion removes more of the rock overlying the Cenozoic intrusives. A basic pegmatite of probable Tertiary age occurs in the Cooke City district of Montana.\textsuperscript{30} In the Carlingford district of Ireland, the Carboniferous limestone has been metamorphosed by a series of Tertiary intrusives, ranging from basic to acidic. Pegmatite satellites of the acidic Tertiary magma reacted with the skarns formed through the earlier metamorphism to produce an unusual suit of minerals.\textsuperscript{31} Another example of Cenozoic pegmatites, in northern Italy immediately south of the southeastern corner of Switzerland, has been described by Cornelius.\textsuperscript{32} Tertiary pegmatites containing beryl, dumortierite, and uraninite occur in this area.

**Summary and Conclusions**

The greater number of the known pegmatites of the world are pre-Cambrian in age, although Paleozoic and Mesozoic pegmatites are common in areas which have been scenes of intrusive igneous activity during those eras, and Cenozoic pegmatites, although uncommon, are not unknown. There are several reasons for the predominance of pre-Cambrian pegmatites. In the first place the outcrop area of the pre-Cambrian is much greater than that of the younger crystalline rocks. For example, approximately 30 per cent of North America is covered by pre-Cambrian at the surface (or immediately beneath the mantle rock) and of the remaining 70 per cent only a very small proportion is represented

\begin{itemize}
\item \textsuperscript{29} Holmes, Arthur, Op. cit., p. 315.
\item \textsuperscript{30} Lovering, T. S., Magmatic chalcopyrite, Park County, Montana: Econ. Geology, vol. 19, pp. 636-640, 1924.
\item \textsuperscript{31} Osborne, G. D., The metamorphic limestones and associated contaminated igneous rocks of the Carlingford district, Co. Louth: Geol. Mag., vol. 69, no. 815, pp. 209–233, 1932.
\end{itemize}
by crystalline rock outcrops. Furthermore, the time represented by the exposed pre-Cambrian is over two-thirds of the known span of geologic time. During this long period a number of revolutions which were accompanied by large-scale igneous intrusion and pegmatite mineralization took place. A possible explanation, beside the selective solution theory of Lane\textsuperscript{33} or the differential anatexis theory of Eskola\textsuperscript{34} and others, of the much greater abundance of lit-par-lit pegmatites in the pre-Cambrian lies in the schistose condition of much of the country rock into which the pre-Cambrian batholiths were intruded. This type of surrounding rock encouraged the movement of magmatic liquids along planes of easier penetration. Similar pegmatization of the country rock took place in New England and portions of the Appalachian area during Paleozoic time where the pre-intrusive rock was very similar to much of that in the pre-Cambrian. As a general rule, younger intrusives have encountered rock of much more homogeneous character (in respect to permeability) so that the magmatic solutions, instead of forming lit-par-lit pegmatites, deposited feldspar, quartz, and other minerals in a contact metamorphic aureole in the adjacent rock.

Pegmatites are most abundant where erosion has stripped off the greater part of the cover above the source batholith. But erosion down to the "mountain roots" is not essential. Both Anderson\textsuperscript{35} and Thomson and Ballard\textsuperscript{36} have pointed out the upward increase in abundance of pegmatites in the upper part and overlying shell of the Idaho batholith. Similar observations have been made in parts of the Canadian Shield area where pegmatites are very abundant in the country rock adjacent to batholithic cupolas.

**DISTRIBUTION**

**INTRODUCTION**

The following pages contain a compilation of pegmatite occurrences throughout the world. Principal localities are listed for


\textsuperscript{34} Eskola, Pennti, On the differential anatexis of rocks: *Comptes Rendus Soc. Geol. de Finlande*, vol. 7, pp. 12–25, 1933.


each geographic division, and brief mention is made of the more important pegmatite types. The nomenclature used is that which was employed by the writer in a recently published classification of pegmatites. The discussion under each geographic division is followed by a selected list of references. In addition the following publications were freely drawn upon:


Maps are included (Plates I to VI) for each continent. These give the distribution of complex acidic, intermediate, and basic pegmatites. Simple acidic pegmatites are not shown. Their areas of outcrop would include most of the pre-Cambrian shield of the globe and also numerous localities where younger intrusives are exposed. The symbols used on the maps in some instances refer to single pegmatite bodies, but in most cases they are intended to include a district.

The writer appreciates that the following compilation of pegmatite localities is not a complete one. However, he does believe that most of the important pegmatites (those that have yielded specimens of economic or mineralogical interest) have been included. Beside these a large number of minor occurrences of pegmatite are mentioned. The latter are included in order to give an adequate picture of the very widespread distribution of pegmatite bodies.

The writer is grateful to the College Students Employment Project for the services of Robert Ferris as a bibliographic assistant, and to the Graduate Research Committee of the University of Kansas for a grant defraying the cost of the map cuts.

NORTH AMERICA

UNITED STATES


Maine. Principal localities: Mainly in Oxford and Androscoggin counties, but some in Sagadahoc, Kennebec, Hancock and other counties. Mount Mica, Mount Apatite, Poland, Rumford, Stoneham, Hebron, Albany, Buckfield, Greenwood, Newry, and Topsham are the more famous place names. Types of pegmatite: Granite, both simple and complex. In the latter beryllium, boron, lithium, phosphate, and fluorine (topaz) phases may be well developed.


New Hampshire. Principal areas: Grafton and Cheshire counties; also Sullivan, Merrimack, and Hillsboro. Important localities are Grafton, Orange, Rumney, Alexandria, Acworth (and South Acworth), Sullivan, Gilsum, Alstead, Roxbury, Danbury, Baldface Mt., and Milford. Types of pegmatite: Many are granite complex, with beryllium, fluorine, and boron (tourmaline) phases. Milford pegmatite is granodiorite.


Vermont. Localities: Barre, Chester, and Robeson Mt. (Woodbury). Type: Granite simple.


Massachusetts. Principal localities: Chesterfield, Goshen, Lithia, Royalston, Northfield, Uxbridge, Quincy, Winchester,
Rockport (Cape Ann), and western Hampden County. Types of pegmatite: Common granite and alkaline granite (Quincy and Rockport). Some are complex with boron, lithium, beryllium, or rare earth phases. Pegmatites containing diopside intrude limestone in western Massachusetts.


**Rhode Island.** Principal localities: Southwestern Rhode Island in the vicinity of Westerly, west coast of Narragansett Bay, and Diamond Hill. Types of pegmatite: Granite, mainly simple, and alkaline granite (Diamond Hill).


**Connecticut.** Principal localities: Portland, Middletown, South Glastonbury, Haddam Neck, Trumbull, Branchville, New Milford, and Chatham. Types of pegmatite: Granite, the larger ones complex. A lithium phase is prominent at Chatham, a beryllium phase at Haddam Neck, a phosphate phase at Branchville, a fluorine phase at Trumbull, and both lithium and phosphate phases at Portland.


**New York.** Principal localities: Pierrepont, De Kalb and Gouverneur in St. Lawrence County; Saratoga and Fulton counties;
Chester, Bedford, and New York City; and many localities in the Adirondacks. Types of pegmatite: Granite, and in the Adirondacks granodiorite (or quartz-diorite) and diorite. The Fordham gneiss is thoroughly impregnated with pegmatite. The Bedford pegmatite is complex with a rare earth phase, a boron phase is present in several of the St. Lawrence County deposits, and many of the pegmatites in the Adirondacks have an iron ore (magnetite) phase.


NEW JERSEY. Principal localities: Abundant in the pre-Cambrian crystalline rocks composing the highlands of northern New Jersey. A minor occurrence is in the Triassic diabase of the Palisades. Types of pegmatite: Granite, in a number of localities with a magnetite phase.


PENNSYLVANIA. Principal localities: Southeastern Pennsylvania, especially Chester and Delaware counties. Types of pegmatite: Simple granite, granite complex with beryllium and iron ore (magnetite) phases, and syenite pegmatite (“soda pegmatites” of Bastin) adjacent to the Maryland line.


DELAWARE. Simple pegmatites occur at the northern end of the state adjacent to Pennsylvania.
MARYLAND. Principal localities: Montgomery, Howard and Baltimore counties, and Cecil County in the northeastern corner. Types of pegmatite: Granite, except for syenite pegmatites in Cecil County adjacent to Pennsylvania. Complex pegmatite in Montgomery County. Diopside in Howard County pegmatite due to intrusion into dolomite.


VIRGINIA. Principal localities: East-central Virginia, especially Amelia, Goochland, and Hanover counties; west-central Virginia, especially Rockbridge, Amherst and Henry counties, and Loudoun County in northern Virginia. Types of pegmatite: Granite, many of them complex with titanium, zirconium, and rare earth phases prominent. Kyanite occurs in pegmatite in southwestern Virginia. Diabase pegmatites of Triassic age occur in Loudoun County.


NORTH CAROLINA. Principal localities: Pre-Cambrian crystalline rock area toward the western end of the state, especially in Alexander, Cleveland, Burke, Mitchell, Yancey, Avery, Haywood, Macon, and Jackson counties. Types of pegmatite: Granite simple and complex. Latter exhibit the following phases: rare earth (especially at Spruce Pine), magnetite (Cranberry), tin, and beryllium (producing common beryl, aquamarine, and emerald).
Kyanite and hiddenite are unusual pegmatite minerals found in North Carolina.


**ARKANSAS.** Locality: Magnet Cove. Type of pegmatite: Nephelite-syenite with rare alkaline mineral phase.


**OKLAHOMA.** Locality: Pre-Cambrian crystalline rock exposure in Wichita Mountains, southwestern Oklahoma. Types of pegmatite: Alkaline granite (Greer County) and zircon pegmatite near Indiahoma.

**REFERENCE:** Rogers, A. F., Aegirite and riebeckite rocks from Oklahoma: *Jour. Geology*, vol. 12, pp. 283–287, 1907.

**MISSOURI.** Locality: Camden County, western Missouri. Type of pegmatite: Granite, simple.


**MICHIGAN.** Pegmatite localities: Pre-Cambrian portion of the upper peninsula. Type of pegmatite: Granite, simple.


**WISCONSIN.** Pegmatite localities: Pre-Cambrian area of north central Wisconsin. Types of pegmatite: Granite and nephelite-syenite.


**MINNESOTA.** Pegmatite localities: Pre-Cambrian area, especially the northern part of the state. Types of pegmatite: Granite, some with a magnetite phase, and gabbro in the vicinity of the Duluth gabbro.


**SOUTH DAKOTA.** Principal localities: Confined to the pre-Cambrian area of the Black Hills, especially the vicinities of Key-
stone and Custer. Types of pegmatite: Granite simple and complex, with strong lithium phase and less marked beryllium and tin ore phases in several.


**Montana.** Principal localities: Associated with the intrusive rocks in the western part of the state. Types of pegmatite: Granite (simple) and basic.


**Wyoming.** Principal localities: Widely scattered in the pre-Cambrian areas of Laramie, Albany, and Carbon counties in the southeastern part of the state, in northern Fremont County in west-central Wyoming, and along the eastern edge of Crook County in the northeast corner where the Black Hills extend into Wyoming. Types of pegmatite: Granite, mainly simple. Fremont County pegmatites are complex, containing lithium minerals and beryl, and Crook County pegmatites contain cassiterite.


**Colorado.** Principal localities: In practically every county in the Front Range extending from the Wyoming line south to Fremont County in south central Colorado and in pre-Cambrian areas to the westward. Types of pegmatite: Mainly granite and
quartz monzonite. A fluorine phase is well developed in the Pikes Peak-St. Peter's Dome region. Ore mineral phases occur in Boulder County and in the Georgetown district (magnetite). A newly-described pegmatite near Ohio City in the Gunnison Valley exhibits a strong lithium phase. A beryllium phase is important at Mount Antero and elsewhere in the upper Arkansas River valley.


**New Mexico.** Principal localities: In north-central New Mexico on both sides of the county line separating Rio Arriba and Taos counties and southeastward into Mora and San Miguel counties. Types of pegmatite: Granite simple, and complex with a rare earth phase near Petaca, Rio Arriba County, a lithium phase in the vicinity of Embudo in Taos County, and a molybdenite phase near Porvenir in San Miguel County.


**Utah.** Principal localities: Park Valley district in northwestern Utah; Deep Creek Mountains south of Gold Hill in west-central Utah; and Beaver and San Francisco ranges in southwestern Utah.
Types of pegmatite: Granite and quartz monzonite. Complex with ore mineral phase at Park Valley, Spring Creek (Deep Creek Mountains), and Beaver Lake. Beryl also present in Deep Creek Mountains.


IDAHO. Principal localities: In and surrounding the great batholith of north-central Idaho, especially in Latah County, and in Cassia County in southern Idaho. Types of pegmatite: Granite, mainly simple. Some beryl is found in the Latah County deposits and molybdenite occurs in pegmatites in Boundary and Lemhi counties. A hornblende pegmatite has been found in western Clearwater County.


NEVADA. Principal localities: A few widely scattered pegmatites have been reported from the southeastern (northeastern Clark County) and southwestern (especially Bullfrog Hills) parts of the state and from the Rochester mining district in northwest central Nevada. Types of pegmatite: Granite, with a gold phase in the Rochester district and a molybdenite phase in southwestern Nevada.


CALIFORNIA. Principal localities: Pegmatites have been reported from about 14 counties scattered over northern, east-central, and southern California. The most important district is in Riverside and San Diego counties in southern California. Types of pegmatite: Granodiorite simple in Sierra Nevada ranges in east-central and northern California. Granite complex in San Diego and Riverside counties with a very prominent lithium phase.
Other phases present are boron (tourmaline), beryllium, molybdenum, and rare earth (monazite).


OREGON. Locality: Wallowa Mountains in the northeastern part of the state. Type of pegmatite: Granodiorite.


WASHINGTON. Principal localities: Silver Hill, near Spokane, Ferry and Okanogan counties in the northeastern part of the state, Chelan County in north-central Washington, and Bald Butte Ridge in southeastern Washington. Types of pegmatite: Mainly granite simple. The Silver Hill pegmatite is complex with a tin phase and molybdenite-bearing pegmatites occur in central and northern Okanogan County. The pegmatites in northern Ferry County are complex syenite with a copper sulphide phase.


ALASKA. Principal localities: In Coast Range intrusives in southeastern Alaska and widely scattered occurrences in the in-


CANADA


NEWFOUNDLAND, LABRADOR, AND BAFFIN ISLAND. Principal localities: Widely scattered over pre-Cambrian shield; also in ultrabasic rocks of Labrador coast. Types: Granite simple; pure labradorite pegmatites in Labrador.

NOVA SCOTIA. Principal localities: Lunenburg (especially New Ross), Halifax, and Cape Breton counties. Type: Granite. Complex pegmatites with lithium and ore mineral phases occur in Lunenburg County and a molybdenite phase is found near Cape Breton.


**Quebec.** Principal localities: Widely scattered over the great pre-Cambrian shield; and in the Paleozoic intrusives of Mount Royal, Montreal. Pegmatites are especially abundant in the Abitibi region of southwestern Quebec, in a 100-mile wide strip north of Ottawa River between Calumet Island and Montreal, and north of St. Lawrence River and Gulf of St. Lawrence between Quebec and the east end of the Saguenay district. Types of pegmatite: Mainly granite simple and complex. Latter exhibit an important molybdenite phase at Kewagama Lake and elsewhere in Abitibi district, northwest of Ottawa in Hull-Quyon area, along south shore of Lake St. John, and in the Saguenay district near the mouth of Manikuan River and at Romaine. A rare earth phase occurs in pegmatites near Wakefield (northwest of Hull), Buckingham, in Berthier County north of Montreal, north of Murray Bay (northeast of Quebec), and at several localities in Chicoutimi County east of Lake St. John. Beryllium phases are found in Abitibi district and 100 miles north of Montreal (chrysoberyl). Graphite occurs in pegmatite at Louisa, north of Lachute, and lithium minerals at Wakefield and on Walrus Island, Paint Hills group, James Bay. The pegmatites at Mount Royal are nephelite syenite. Basic pegmatites exhibiting a phlogopite-apatite phase occur north of Ottawa.


**Ontario.** Principal localities: Widespread over province, but exceedingly abundant in broad belt extending eastward from Sudbury and Georgian Bay to the provincial boundary. Types of pegmatite: Alaskite simple, granite simple and complex, syenite and nephelite syenite simple and complex, and basic complex. Phases present in complex granite pegmatites: Molybdenite in Frontenac,
Renfrew, and Haliburton counties, and Lake Superior and Kenora districts; beryl in Renfrew County and Nipissing and Rainy River districts; rare earth (especially radioactive minerals) in Carleton, Lanark, Renfrew, Hastings and Haliburton counties, and Nipissing, Parry Sound and Sudbury districts; calcite in Hastings and Haliburton counties; lithium in Lanark County; and iron ore in Rainy River district. Syenite (and nephelite syenite) pegmatites occur in Frontenac, Renfrew, and Hastings counties and along French River in the Parry Sound district. These exhibit a corundum phase in Renfrew and Hastings counties. Basic pegmatites have been found near Wilberforce in Haliburton County and in the phlogopite-apatite district of southeastern Ontario.


Manitoba. Principal localities: Southeastern and northwestern (between Wekuska Lake and Saskatchewan line) portions of province. Types: Granite simple and complex, and a few diorite pegmatites in northwestern Manitoba. Phases in complex granite pegmatites are lithium, beryl, tin, molybdenite, and rare earth minerals, all in southeastern Manitoba, and sulphide ore phase in northwestern Manitoba.


**Saskatchewan.** Simple granite pegmatites are fairly numerous in parts of northeastern Saskatchewan.

**Reference:** Wright, J. F., *Canada Geol. Survey, Summary Rept.* 1932, p. 90 C.

**British Columbia.** Principal localities: Widely scattered over eastern and southern British Columbia and in northern British Columbia near Fort Graham and on the coast in the neighborhood of Douglas Channel. Types: Granite simple and complex, monzonite complex, and basic complex. Complex granite pegmatites with a molybdenite phase occur south of Salmo and west of Nelson (Molly mine). A beryl phase is found near Tete Jaune and rare earth minerals occur in a basic pegmatite on Moose Creek, southeast of Leachoir. A copper sulphide ore phase has been observed in pegmatites on the shores of Douglas Channel and at Copper Mountain in the Yale district. The latter pegmatite is a monzonite in composition.


**Greenland**

Localities: Mainly on south and west coasts. Types: Granite and alkaline syenite. Complex with molybdenite phase near Egedesminde and Sydproven. Rare earth mineral phase present in Julianehaab district (in soda syenite pegmatites) and at Kara Akimgirait (East Greenland) and Kikertak (Upernivik district). Graphite-bearing pegmatites occur on Lango (Long) Island. The
famous cryolite deposit of Ivigtut is considered to be a pegmatite in which the fluorine phase is so strongly developed that cryolite has been substituted for feldspar.


MEXICO

Localities: Muscovite has been intermittently mined from a number of pegmatites in Lower California and Sonora. Type: Probably granite simple.

GUATEMALA

Localities: Departments of El Quiche and Baja Verapaz. Types: Muscovite pegmatites, probably granite simple.

SOUTH AMERICA


BRAZIL. Principal localities: Scattered through ancient crystalline rocks of Minas Geraes, Bahia, Goyaz, and Sao Paulo. Types: Granite simple and complex. Former are very widespread and have been the source of commercial mica in all four provinces. Complex pegmatites are found in greatest abundance in Minas Geraes and Bahia. A zone crossing the two provinces 600 miles long and 100 miles wide parallel to the coast and about 50 miles inland contains pegmatites with a prominent beryllium phase. Some of the beryl localities are S. Anna de Onca, Glycerio (near Rio de Janeiro), and Esmeralda and Bom Jesus dos Meiros (emeralds). Brazil is a most important tourmaline producer, mainly from pegmatites at Lajao, Minas Geraes. A fluorine phase occurs on the island of Pescaria (south of Rio de Janeiro) and at Piracicabao, Minas Geraes. Gold occurs in pegmatites at Passagem. At the following localities the pegmatites exhibit a radioactive mineral phase: Santa Clara do Pomba, Divino de Ubá, São Sebastião de Correntes, Palmeira de São Jose da Lagoa, São Jose de Brejauba de Ferros.
PLATE II. Distribution of complex acidic pegmatites in South America.


ARGENTINA. Principal localities: The Sierra von Cordoba and other ranges in the provinces of Cordoba, San Luis, San Juan, Catamarca, and Salta, northwestern Argentina. Types: Mainly granite simple. Complex, with ore mineral ( wolframite, molybdenite, and copper sulphide) phase in the Sierra von Cordoba. Tantalite and beryl occur in pegmatite near Quines, San Luis Province.


CHILE. Pre-Cambrian crystalline rocks occur in a long narrow belt along the Chilean coast. Beryl has been reported from the Valparaiso district.

BOLIVIA. Principal locality: Metal mining province of western Bolivia. Type: Granite complex, with tin, tungsten, and lithium phases.


PERU. Muscovite-bearing pegmatites occur in the vicinity of Arequipa, Southern Peru.

COLOMBIA. Localities: near Muzo, and in the southern part of the eastern cordillera. Types: Granite simple, and complex with beryllium (emerald) phase in Muzo district.


(To be continued)