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Polytypism of chlorite in very low grade metamorphic rocks

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For deposit: Occurrences of various chlorite polytypes

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OCCURRENCES OF TYPE I CHLORITE

Appendix to accompany:

Polytypism of chlorite in very low-grade metamorphic rocks

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The occurrences in these tables are divided according to the following codes. The code number appears in the left-hand margin of each table. Reference numbers are listed in parentheses following each description. Sample descriptions are transcribed directly from the original sources.

Lithologic Codes

1-altered volcanic rock
2-associated with iron formations
3-hydrothermal veins
4-limestone
5-sandstone
6-regional metamorphic rock
7-pegmatite
8-ultramafic rock
9-other

References (see original text for full citation)

(1) Bailey and Brown (1963) Amer. Mineral. **47**, 819-850.
(2) Bailey, personal communication, 1986
(3) Hayes (1970) Clays & Clay Minerals **18**, 285-306.
(4) Karpova (1969) Sedimentology **13**, 5-20.
(5) Weaver et al.(1983) in Weaver, C.E. and Associates, Shale-Slate Metamorphism in the Southern Appalachians, 99-139.
(6) Beskin (1984) Programs and Abstracts of the 20th Annual Meeting of the Clay Minerals Society, 25.

Type Ib(ß=90°)

1 Chihuahua, Mexico. Green lenses in altered sill (1).

6 Keene-Antwerp district, New York. Quartz-chlorite-pyrite schist country rock to hematite ore body (1).

5 Sacramento Mountains, New Mexico. Matrix in feldspathic sandstone near top of Fresnal Group, upper Pennsylvanian (1).

5 Tuscaloosa sandstone, Upper Cretaceous, Gulf Coast area. Light green matrix to loosely cemented sand in core at 8300 feet (1).

3 Ahmeek mine, Keweenaw Point, Michigan. Black coating in breccia with calcite, quartz, and Cu-arsenides (1).

3 White Pine mine, Michigan. Greenish chlorite in veinlets in siltstone (1).

1 Amethyst Harbor, north shore of Lake Superior. Altered mafic minerals in coarse grained igneous rock (1).

5 Presque Isle Park, Marquette, Michigan. Reworked periodotitic material in base of Eastern sandstone (1).

2 Palmer area, Marquette district, Michigan. Late stage alteration of Negaunee iron-formation (1).

3 Ravenna-Pickett mine, Crystal Falls district, Michigan. Altered fragmental material with 7 Å chamosite (1).

2 Vicar mine, Gogebic district, Michigan. Vug fillings in Ironwood iron-formation, with pyrite and quartz (1).

2 Thunder Bay, north shore of Lake Superior. Diagenetic replacement of 1M muscovite granules in tuffaceous, carbonate facies of upper Gunflint iron-formation (1).

2 Stephen's mine, Mesabi district, Minnesota. Drill hole in upper Pokegama quartzite, in granules with quartz, greenalite, magnetite and stilpnomelane (1).

2 Embarrass mine, Mesabi district, Minnesota. Matrix in basal conglomerate of Biwabic iron-formation (1).

2 Florence, Wisconsin. Massive garnet-chlorite rock associated with iron-formation (1).

2 Badger pit near Florence, Wisconsin. Interlayered with chert and hematite in Riverton iron-formation (1).

2 Davidson pit near Florence, Wisconsin. Slaty rock associated with Riverton iron-formation (1).

2 Florence, Wisconsin. Greenish layer, probably in Michigamme formation (1).

2 Commonwealth mine, Florence, Wisconsin. Interlayered with chert and hematite in Riverton iron-formation (1).

2 Florence mine near Florence, Wisconsin. Fractured filings in hematite ore body (1).

3 Arakawa mine, Japan. Hydrothermal veins in ore (2).

3 Tazawa mine, Japan. Kaolinite in hydrothermal quartz-copper vein (2).

3 Sayama mine, Japan. Hydrothermal vein (2).

2 Meress pit near Florence, Wisconsin. Riverton iron-formation (2).

3 Osaruzawa mine, Japan. Veins in ore (2).

9 Gaither Mountain, Arkansas. Diagenetic morphology. Pellets in Brentwood member of Boyd formation (2).

4 Broncks Lake, New York. Authigenic; fills cavities in and replaces fossil fragments in recrystallized sparry limestone; with 2M1 clay-size mica. M-387, (3).

5 Core, Clay Co., West Virginia, 2010'. Authigenic; lines pores in sandstone; cf. M-237. M-479, (3).

4 Evansville, Arkansas. Authigenic or halmyrolytic; oolith-like sheaths around quartz and calcite nuclei. M-437, (3).

4 Braggs Mt. near Braggs, Oklahoma. Authigenic; replaces fossil fragments as clay pellets, ooliths in sandy limestone. M-463, (3).

4 Gaither Mt. SW Harrison, Arkansas. Authigenic; abundant clay pellets, fills and replaces fossil debris in sandy limestone. M-95, M-201, (3).

5 Gaither Mt. SW Harrison, Arkansas. Authigenic; replaces feldspar? grains in sandstone, some clay pellets; weathers to Ia random mixed-layer chlorite-vermiculite. M-283, (3).

4 Scotland, Arkansas. Authigenic or halmyrolytic; clay pellets, ooliths. M-228, (3).

4 Winslow, Arkansas. Authigenic; ooliths, clay pellets in sandy limestone; weathers to Ia chlorite. M-231, (3).

5 Eddy Co., New Mexico, core, 9000'. Authigenic; replaces feldspar? in conglomerate sandstone, some squeezed in matrix position; with authigenic kaolin and detrital rock fragments with IIb chlorite. M-481, (3).

5 Hemphill Co., Texas, core, 11,087'. Authigenic; fibrous growth rims around chloritized mineral grains, replaces feldspar along cleavages, some in matrix of arkosic conglomeratic sandstone. M-271, (3).

5 Allen Co., Kansas, core, 900'. Authigenic?; completely fills pores in sandstone, but is absent between quartz grains in contact. M-483, (3).

5 Albany Co., Wyoming. Authigenic; coats sand grains, replaces mineral and rock grains in sandstone; with IM mica (glauconite). M-104, (3).

5 Rocky Mt. Foothills, Alberta. Authigenic; fibrous chlorite lines pores in sandstone; lithic grains altered to montmorillonite. M-292, (3).

5 Gulf Coast, core, 8300'. Authigenic; the definitive example of growth rims in pore spaces in sandstone. M-237, (3).

5 Claiborne Ph.,Louisiana, core, 2800'. Authigenic or halmyrolytic; "glauconite" pellets and replacements of sand-size feldspars in sandstone. M-482, (3).

5 Rocky Mt. Foothills, Alberta. Authigenic; very well crystallized; lines and fills pores, replaces grains in magnetic sandstone. M-293, (3).

5 Kenai Peninsula, Alaska, core, 11,419'. Authigenic; replaces sand-size detrital biotite and vermiculitized biotite in feldspathic lithic wacke; chlorite formed after compaction and lithification. M-484, (3).

5 Poul Creek, 60°03' N, 141°59' W, Gulf of Alaska. Authigenic; lines pores, replaces rock

and mineral grains, replaces calcite cement, replaces weathered biotite and glauconite grains in graywacke. PC-4, (3).

5 Bolshoy Donbas, USSR. Cement in polymictic sandstone. (4).

5 Tuscaloosa Fm., Gulf Coast. Authigenic chlorite. Borehole temperature = 380°F (~190° C); depth = 20,516 ft. Occurs with type II*b* chlorite. (6)

Type Ib(ß=97°)

1 New Britain, Connecticut. Vesicle fillings in basalt (1).

3 Hercules mine, Couer d'Alene, Idaho. Vein in Pb-Zn-Cu-Fe ore, with biotite and garnet (1).

2 Havange, France. Green-black matrix to oolites in black iron ore bed (1).

2 Moulaine, France. Green matrix to oolites in green iron ore bed (1).

3 White Pine mine, Michigan. Brownish chlorite replacing greenish orthohexagonal Ib chlorite in veinlet in siltstone, with orthorhombic chalcocite and quartz (1).

2 Vicar mine, Michigan. Drill hole in altered pyroclastics of Ironwood iron-formation, with biotite and hematite (1).

2 Vicar mine, Michigan. Granules associated with carbonate in the jasper-magnetite horizon of the Ironwood iron-formation (1).

2 Near Mountain Iron, Mesabi district, Minnesota. Irregular granules in Upper Slaty Biwabic iron-formation (1).

2 Badger pit near Florence, Wisconsin. Massive olive-green material in Riverton iron-formation (1).

1 Silver Islet mine, Nipigon Bay. Altered mafic minerals in Keweenawan dike (1).

1 Big Bay, north shore of Lake Superior. Altered mafic minerals in fine grained igneous rocks (1).

1 Portage Bay Island, north shore of Lake Superior. Altered mafic minerals in fine grained igneous rocks (1).

1 Thunder Bay, north shore of Lake Superior. Altered mafic minerals in igneous rocks (1).

1 Drill hole near Chillagoe, Queensland. Alteration of brecciated andesite and skarn. Zinc-rich chlorite (2).

3 White Pine copper mine, Michigan. Quartz vein. Brown chlorite at center of vein bordered by green Ib (B=90') chlorite near vein walls. Included chalcocite suggests deposition below

105° C (2).

4 West Fork, Arkansas. Authigenic; lines pores, clay pellets and ooliths, fills and replaces fossil fragments. M247, (3).

4 Brentwood, Arkansas. no thin section. M-229, (3).

4 Sequoyah State Park, Oklahoma. Authigenic; fills cavities in fossils, notably encrusting foraminifers, replaces fossil debris. M-203, (3).

4 Lee Cr., Washington Co., Arkansas. Authigenic; clay pellets in sandy limestone. M-230, (3).

9 Baralaba, Queensland, Australia. Authigenic; altered kaolinite crystal tonstein in semi-anthracite coal; chlorite intergrown with IM dioctahedral mica in macrocrystals. M-477, (3).

Type Ib_d

4 Fayetteville, Arkansas. Authigenic; clay pellets, replaces fossil debris in conglomeratic limestone. M-96, (3).

4 Near Tenkiller Ferry Dam, Oklahoma. Authigenic; fills body chambers of brachiopods and cephalopods, some clay pellets; with mixed layer $1M_d$ mica-montmorillonite in conglomerate limestone. M-447, (3).

1 Loving Co., Texas, core. Authigenic; devitrification product of volcanic glass in bentonite. M-419, (3).

4 Werl, Nordrhein-Westfalen, West Germany. Authigenic or halmyrolytic; fills planktonic foraminifers, mainly globigerinids in arenaceous glauconitic limestone; glauconite pellets are I M mica. M-103, (3).

9 Near Guadalupe Is., Baja California, Mexico. Authigenic; coats silt-size quartz grains in eolian sediment layer; formed from Fe-Al oxide hydrate coatings (desert varnish) on silt grains. M-470, (3).

Type Ia

8 Erzincan district, Turkey. Purple Cr-chlorite in serpentinite-chromite complex (1).

2 Auburn mine, Mesabi district Minnesota. From slickensided surface in upper part of Lower Slaty Biwabic iron-formation (1).

2 Embarrass mine, Mesabi district, Minnesota. Recrystallization of earthy orthohexagonal Ib chlorite near quartz veinlet in basal conglomerate of Biwabic iron-formation (1).

2 Vicar mine, Gogebic district, Michigan. Drill hole in Ironwood iron-formation, interlayered with chert and stilpnomelane in the jasper-magnetite horizon (1).

7 Londonderry, Western Australia. Cookeite in pegmatite (1).

7 Morning Star mine, Victoria, Australia. Cookeite in pegmatite (1).

7 Brazil. Cookeite in pegmatite (1).

7 Mt. Mica, Paris, Maine. Cookeite in pegmatite (1).

7 Buckfield, Maine. Cookeite in pegmatite (1).

7 Haddam Neck, Connecticut. Cookeite in pegmatite (1).

9 Carbonatite, South Africa (2).

4 New England Lime Quarry, Cannan, Connecticut. With phlogopite (2).

9 Fault gouge, Broken Hill, Australia (2).

3 Pulaski County, Arkansas. Cookeite in quartz vein with dickite and IIb chlorite (2).

8 Sierra Leone, West Africa. Alteration of phlogopite in kimberlite nodules with IIb chlorite and vermiculite(2).

8 Woodline Well, West Australia. Ni-rich chlorite. Drill cuttings from ultramafic body near a Ni-mine (2).

9 Benallt mine, North Wales (called grovesite). Mn-rich chlorite forming a crust on Mn-ore (2).

9 West Tanganyika. Sangu carbonatite. Alteration of phlogopite during metasomatic phase (2).

1 Isabella mine, Marquette district, Michigan. Alteration of mafic dike (2).

1 Thunder Bay, Lake Superior, Ontario, Canada. Authigenic; fills vesicles, replaces glassy matrix and primary crystals in altered tuff; with authigenic IMd dated 1900+/- 200m.y.. M-205, (3).

5 West Fork, Arkansas. Authigenic; lines and fills pores, replaces feldspars; with authigenic kaolinite; weathers to Ia random mixed-layer chlorite-vermiculite. M-241, (3).

4 Leslie, Arkansas. Authigenic; partially replaces calcite ooliths; may have weathered from Ib (B=90'), cf. M-231. M-440, (3).

4 Woolsey, Arkansas. Authigenic; replaces crinoid debris, weathered from Ib (B=90') in sandy crinoidal limestone. M-427, (3).

5 J.D. Creek, Bastrop Co., Texas. Halmyrolytic or authigenic; "glauconite" pellets, mixtures of Ia and 10 A mineral; proportions of each are related to depositional environment. M-476, (3).

6 S. Appalachians. Mudstone with incipient slaty cleavage, zone of high grade diagenesis. (5).