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A GLOSSARY OF URANIUM- AND THORIUM-BEARING MINERALS

by

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Introduction

The U. S. Geological Survey has for some time been making a systematic survey of data pertaining to uranium and thorium minerals and to those minerals which contain traces or more of uranium and thorium. This survey consists of collecting authoritative chemical, optical, and X-ray diffraction data from the literature and of adding to this data, where it is inadequate, by work in the laboratory. The results will be reported from time to time, and the authors welcome information on additional data and names.

The first of a series of reports on these results is this glossary of uranium- and thorium-bearing minerals. The glossary is divided into four groups: A, minerals containing uranium and thorium as major constituents; B, minerals containing minor amounts of uranium and thorium; C, minerals which, if investigated by modern analytical methods, might show uranium or thorium content; and D, minerals which are non-uranium- or non-thorium-bearing, but which have been reported to contain impurities or intergrowths of uranium, thorium, or rare-earth minerals. Uranium is more widespread in its natural occurrence than generally has been supposed, and it is possible that the third group of minerals will give valuable information upon reinvestigation.

Such a glossary has long been needed to alleviate the confusion which obscures the nomenclature of these minerals. For many of them the confusion will remain until more thorough research is done. Some species always may be subject to question as their type specimens have been lost and existing specimens bearing the species name have been found to be other substances (e.g., in group A, uranochalcite and voglianite). Structural formulas are given for most of the minerals. Oxide formulas are given where no good structural data are available. The glossary summarizes the state of our knowledge, as of August 1949, concerning the validity of all the included species. Identities and group relations are indicated. It might be well to relegate to obscurity the many synonyms existing in the literature.

In the index there are 325 entries which represent 81 species containing uranium and thorium as major constituents, 39 species containing small amounts of uranium and thorium, 29 species which should be tested for uranium and thorium, and 13 species which have been reported to contain impurities or intergrowths of uranium, thorium, or rare-earth minerals. These four categories are shown in the index by reference letters.

For most of the minerals a reference has been chosen from standard reference books and easily available journals. Dana VI and Dana VII stand for the 6th and 7th editions, respectively, of Dana's System of Mineralogy.

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I N D E X

(A) indicates minerals containing uranium or thorium as major constituents.
(B) indicates minerals containing minor amounts of uranium or thorium.
(C) indicates minerals which should be tested for uranium and thorium content.
(D) indicates minerals which are non-uranium- or non-thorium-bearing, but which have been reported to contain impurities or intergrowths of uranium, thorium, or rare-earth minerals.

GROUP A. URANIUM AND THORIUM MINERALS

1. AMPANGABEITE
$(Y,Er,U,Ca,Th)_2(Cb,Ta,Fe,Ti)_7O_{18}$?

Validity of species is questionable; may be an inhomogeneous alteration product.

U = 17.1%, Th = 1.8%

Dana VII, pp. 806-807

Hydroeuxenite - synonym of ampangabeite

Dana VII, p. 806

2. ANDERSONITE
$Na_2Ca(UO_2)(CO_3)_3.6H_2O$

U = 39.15%

Milton, C., U. S. Geol. Survey
Personal communication

3. AUTUNITE
$Ca(UO_2)_2(PO_4)_2.8\text{-}12H_2O$

U = 49.7 to 56.2%

Dana VI, pp. 857-858

Calcouranite - synonym of autunite

Meta-autunite is the hydrate with $8H_2O$

4. BASSETITE
$Fe(UO_2)_2(PO_4)_2.8H_2O$

U = 51%

Mineralog. Mag., vol. 17, pp. 221-236, 1915
Chemie der Erde, vol. 12, pp. 433-450, 1939-40
Frondel, C., Harvard University
Personal communication

5. BAYLEYITE
$Mg_2UO_2(CO_3)_3.18H_2O$

U = 27.8 to 29.2%

Milton, C., U. S. Geol. Survey
Personal communication

6. BECQUERELITE
$2UO_3.3H_2O$?

U = 82.4%

Dana VII, pp. 625-627

Billietite - variety of becquerelite

Am. Mineralogist, vol. 33, pp. 503-507, 1948

7. BETAFITE
$(U,Ca)(Cb,Ta,Ti)_3O_9.nH_2O$?

U = 16.3 to 24.5%
Th = 1.0 to 1.1%

Dana VII, pp. 803-805

Blomstrandite - synonym of betafite

U = 16.3%

Dana VII, pp. 803-805

Mendeleyevite - titanian betafite

U = 13.7%

Dana VII, pp. 803-804

Samirésite - synonym of betafite

U = 18.7%

Dana VII, pp. 803-805

8. BRANNERITE
$(U,Ca,Fe,Y,Th)_3Ti_5O_{16}$?

U = 39.3%, Th = 3.6%

Dana VII, pp. 774-775

9. CALCIOSAMARSKITE
$(Ca,Y,etc.,U,Th)_3(Cb,Ta,Fe,Ti,Sn)_5O_{15}$
and
$(Ca,Y,etc.,U,Th,Zr)_3(Cb,Ta,Fe,Ti)_5O_{16}$

U = 9.4 to 11.3%
Th = 1.9 to 2.9%

Dana VII, p. 772

10. CARNOTITE
$K(UO_2)(VO_4).\frac{1}{2}-1\frac{1}{2}H_2O$

U = 56.3 to 58.4%

Dana VI, Appendix I, pp. 13-14

11. CLARKEITE
$UO_3.nH_2O$?

U = 73.7%

Dana VII, pp. 624-625

12. CUPROSKLODOWSKITE
$Cu(UO_2)_2Si_2O_7.6H_2O$

U = 58.6%

Am. Mineralogist, vol. 19,
p. 235, 1934

Jachymovite = cuprosklodowskite

Mineral Abs., vol. 6,
p. 345, 1936

Uranochalcite - a hydrous copper, uranium, and calcium sulfate of questionable validity.

12. CUPROSKLODOWSKITE (Cont.)

Voglianite - A hydrous calcium and uranium sulfate of questionable validity. The type material of Vogl for uranochalcite and voglianite has not been found. Present museum specimens bearing these names have proven to be cuprosklodowskite.

Vogl, J. F., Gangverhältnisse und Mineralreichtum Joachimsthals, Teplitz, 1857
Věstník Královské České Společnostinauk, 1935, article VII, pp. 1-36

13. CURITE
$Pb_2U_5O_{17}.4H_2O$?

U = 66.2 to 70.1%

Dana VII, pp. 629-631

14. DELORENZITE
$(Y,U,Fe^2)(Ti,Sn)_3O_8$?

U = 8.7%

Dana VII, p. 808

15. DEWINDTITE
$Pb(UO_2)_2(PO_4)_2.3H_2O$?

U = 52.1%

Am. Mineralogist, vol. 7,
p. 162, 1922

Stasite = dewindite? -
$Pb_4U_8P_6O_{43}.nH_2O$?

Am. Mineralogist, vol. 7,
pp. 196-197, 1922

16. DIDERICHITE

Contains uranium, water, and carbonate. Validity of species is questionable.

Soc. belge geologie Bull., vol. 70, pp. 212-225, 1947

17. DJALMAITE
$(U,Ca,Pb)(Ta,Cb,Ti)_3O_9.nH_2O$

May be tantalum equivalent of betafite. May be microlite.

Tavora, E., University of Brazil
Personal communication, Oct. 1949

U = 10.4%

Dana VII, p. 805

18. DROOGMANSITE
No chemical analysis has been made.

May be related to sklodowskite.

Am. Mineralogist, vol. 11, p. 168, 1926

19. DUMONTITE
$Pb_2(UO_2)_3(PO_4)_2O_2.5H_2O$

U = 51.0%

Am. Mineralogist, vol. 10, p. 131, 1925

20. EPIIANTHINITE
$yUO_3.xH_2O$?

No good chemical analysis has been made.

An alteration product of ianthinite.

Am. Mineralogist, vol. 32, pp. 344-350, 1947

21. ESCHYNITE
$(Ce,Ca,Fe?,Th)(Ti,Cb)_2O_6$

Also aeschynite. In eschynite-priorite series.

Th = 9.9 to 15.4%

Dana VII, pp. 793-796

22. EUXENITE
$(Y,Ca,Ce,U,Th)(Cb,Ta,Ti)_2O_6$

In euxenite-polycrase series.

U = 3.0 to 9.0%
Th = up to 4.3%

Dana VII, pp. 787-791

Lyndochite - variety of euxenite

U = 0.6%, Th = 4.3%

Dana VII, pp. 787, 789-791

Tanteuxenite - variety of euxenite

U = 3.0 to 3.8%, Th = tr.

Dana VII, pp. 787, 789-790

Eschwegite - AB_2O_6

A = Y,Er,U,Th
B = Cb,Ta,Ti,Fe

U = 1.7%, Th = 0.5%

May belong to euxenite-polycrase series.

Dana VII, pp. 792-793

Toddite - possibly a mixture of columbite and euxenite.

U = 9.8%, Th = 0.4%

Dana VII, pp. 785-786

23. FERGUSONITE
$(Y,Er,Ce,Fe)(Cb,Ta,Ti)O_4$

In fergusonite-formanite series.

U = 0.8 to 6.3%
Th = 0.7 to 2.5%

Dana VII, pp. 757-762

Adelpholite - synonym of fergusonite? A poorly defined substance, possibly an altered mossite.

Dana VII, pp. 762, 778-779

Arrhenite - an altered fergusonite

Dana VII, p. 762

Bragite - synonym of fergusonite

U = 7.2%

Dana VII, pp. 757, 759, 761

Kochelite - synonym of fergusonite

Dana VII, pp. 757, 761

Risörite - synonym of fergusonite

U = 0.09%, Th = tr.

Dana VII, pp. 757-758, 760-762

Rutherfordite - an altered fergusonite

Dana VII, pp. 757, 761-762

Sipylite - synonym of fergusonite

U = 0.8 to 6.3%

Dana VII, pp. 757, 759-760, 762

23. FERGUSONITE (Cont.)

Tyrite - synonym of fergusonite

Dana VII, pp. 757, 760-761

24. FORMANITE
$(U,Th,Ca)(Ta,Cb,Ti)O_4$

In fergusonite-formanite series.

U = 1.1%, Th = 1.1%

Dana VII, pp. 758, 760, 762

25. FOURMARIERITE
$PbU_4O_{13}\cdot 5H_2O$?

U = 70.1 to 70.8%

Dana VII, pp. 628-629

26. FRITZSCHEITE
$Mn(UO_2)_2[(P,V)O_4]_2\cdot 8H_2O$?

No actual analysis is available.

May be the manganese analogue of torbernite.

Dana VI, p. 860

27. GUMMITE
$UO_3\cdot nH_2O$?

Generic term for minerals occurring as alteration products of uraninite and not otherwise identified.

Group includes silicates, phosphates, and oxides.

U = 31.3 to 70.1%
Th = up to 22.0%

Dana VII, pp. 622-625

Eliasite - synonym of gummite

U = 57.2%

Dana VII, pp. 622-624

27. GUMMITE (Cont.)

Pittinite - synonym of gummite

Dana VII, pp. 622-624

Yttrogummite - synonym of gummite

Alteration product of yttrian uraninite.

Dana VII, pp. 622-624

28. IANTHINITE
$2UO_2.7H_2O$?

U = 70.3%

Dana VII, pp. 633-634

29. ISHIKAWAITE
$(U,Fe,Y,etc.)(Cb,Ta)O_4$

U = 19.3%

Dana VII, p. 766

30. JOHANNITE
$CuU_2(SO_4)_2(OH)_{10}.2H_2O$

U = 55.3 to 61.1%

Am. Mineralogist, vol. 11, pp. 1-5, 1926

Gilpinite = johannite

Am. Mineralogist, vol. 11, pp. 1-5, 1926

31. KASOLITE
$Pb(UO_2)SiO_4.H_2O$

U = 43.6 to 44.5%

Am. Mineralogist, vol. 7, pp. 128-129, 1922

32. KHLOPINITE
$(Y,U^4,Th)_3(Cb,Ta,Ti,Fe)_7O_{20}$?

Also chlopinite, klopinite

May be related to euxenite-polycrase series.

U = 7.2%, Th = 1.9%

Dana VII, p. 792

33. LIEBIGITE
$Ca(UO_2)(CO_3)_2.20H_2O$?

U = 34.3%

Dana VI, p. 308

Uranothallite - synonym of liebigite

Frondel, C., Harvard University
Personal communication

Flutherite - synonym of uranothallite

Dana VI, p. 307

34. MACKINTOSHITE
$(Th,U)SiO_4.H_2O$?

U = 19.7%, Th = up to 39.9%

Dana VI, appendix I, p. 44

Hydrothorite
$ThSiO_4.4H_2O$

Alteration product of mackintoshite.

U = 1.9%, Th = 50.7%

Am. Mineralogist, vol. 13, p. 570, 1928

34. MACKINTOSHITE (Cont.)

Pilberite
$UO_3.PbO.ThO_2.2SiO_2.4H_2O$

Alteration product of mackintoshite.

U = 24.4%, Th = 27.4%

Am. Mineralogist, vol. 13, pp. 464-465, 1928

35. MAITLANDITE
$(U,Th,Pb)SiO_4.3H_2O$?

U = 31.2%, Th = 22.7%

Am. Mineralogist, vol. 16, p. 472, 1931

Nicolayite - close to maitlandite

U = 33.7%, Th = 21.4%

Am. Mineralogist, vol. 16, p. 409, 1931

36. MASUYITE
Hydrated lead uranium oxide.

Validity of species is questionable.

Soc. belge geologie Bull., vol. 70, pp. 212-225, 1947

37. MEDJIDITE
Sulfate of uranium and calcium.

Validity of species is questionable.

Dana VI, p. 978

38. MONAZITE
Essentially $(Ce,La,Nd,Pr)PO_4$ containing ThO_2 and SiO_2

Th = commonly 8%, but up to 26% is reported.

Davidson, C. F., Geol. Survey Great Britain Personal communication

Dana VI, pp. 749-752

Cryptolite - synonym of monazite

Dana VI, pp. 749, 752

Edwardsite - synonym of monazite

Dana VI, p. 749

Eremite - synonym of monazite

Dana VI, pp. 749, 752

Kärarfveite - impure monazite

Dana VI, p. 752

Mengite - synonym of monazite

Dana VI, p. 749

Monazitoid - synonym of monazite

Dana VI, p. 749

Phosphocerite - synonym of monazite

Dana VI, p. 749

Turnerite - synonym of monazite

Dana VI, pp. 749, 751-752

Urdite - synonym of monazite

Dana VI, pp. 749, 752

39. NOHLITE
$(Ca,Mg,Fe,Y,etc.,U)_2(Cb,Zr,Fe^3)_3O_{10}$

Validity of species is questionable.

U = 13.0%

Dana VII, p. 772

40. PARASCHOEPITE
$UO_3.2H_2O$?

U = 80.5%

Am. Mineralogist, vol. 32, pp. 344-350, 1947

41. PARSONSITE
$Pb_2(UO_2)(PO_4)_2.2H_2O$

U = 26.8%

Am. Mineralogist, vol. 8, p. 150, 1923

42. PHOSPHURANYLITE
A lead, calcium, uranium phosphate.

U = 57.3%

Frondel, C., Harvard University
Personal communication

43. POLYCRASE
$(Y,Ca,Ce,U,Th)(Ti,Cb,Ta)_2O_6$

In euxenite-polycrase series.

U = 5.5 to 12.4%
Th = up to 4.7%

Dana VII, pp. 787-791

44. POLYMIGNYTE
$A(Cb,Ti,Ta)O_4$

A = $Ca,Fe^2,Y,etc.,Zr,Th$

Th = 3.4%

Dana VII, pp. 746-766

45. PRIORITE
$(Y,Er,Ca,Fe^2,Th)(Ti,Cb)_2O_6$

In eschynite-priorite series.

U = 0.4 to 3.4%
Th = 0.5 to 14.9%

Dana VII, pp. 793-796

Blomstrandine - synonym of priorite

Also, blomstrandinite

Dana VII, pp. 793-796

46. RAUVITE
$CaO.2UO_3.6V_2O_5.20H_2O$

U = 21.4%

Am. Mineralogist, vol. 8, p. 187, 1923

U. S. Geol. Survey Bull. 750, pp. 68-70, 1935

47. RENARDITE
$Pb(UO_2)_2(PO_4)_2O_6.9H_2O$

U = 58.5%

Am. Mineralogist, vol. 14, p. 244, 1929

48. RICHETITE
Contains Pb and U.

Validity of species is questionable.

Soc. belge geologie Bull., vol. 70, pp. 212-225, 1947

49. RUTHERFORDINE
UO_2CO_3?

Validity of species is questionable.

U = 72.1%

Mineralog. Mag., vol. 14,

50. SALEEITE
$Mg(UO_2)_2(PO_4)_2.8H_2O$

U = 58.4%

Am. Mineralogist, vol. 19, p. 36, 1934

51. SAMARSKITE
$(Y,Er,U,Ca,Fe,Th)(Cb,Ta)_2O_6$

U = 8.4 to 16.1%
Th = up to 3.7%

Dana VII, pp. 797-800

Annerödite - mixture of samarskite and parallel growths of columbite.

Dana VII, pp. 797, 799

Eytlandite - synonym of samarskite

Dana VII, p. 797

Hydrosamarskite - an altered samarskite

Dana VII, pp. 799-800

Plumboniobite - a columbate of Y,U,Pb,Fe,etc.

May be a plumbian variety of samarskite.

Dana VII, p. 800

Rogersite - synonym of samarskite

Dana VII, p. 800

Uranotantalite - synonym of samarskite

Dana VII, p. 797

Vietinghofite - synonym of samarskite

Dana VII, pp. 800-801

Yttro-ilmenite - synonym of samarskite
Dana VII, p. 7[illegible]

52. SCHOEPITE
$4UO_3.9H_2O$?

U = 79.0%

Am. Mineralogist, vol. 8, pp. 67-69, 1923

53. SCHROECKINGERITE
$Ca_3NaUO_2(CO_3)_3(SO_4)F.10H_2O$

U = 29.0%

Am. Mineralogist, vol. 33, pp. 152-157, 1948

Dakeite - synonym of schroeckingerite

54. SENGIERITE
$Cu_2(UO_2)_2(VO_4)_2O.10H_2O$?

U = 47.2%

Am. Mineralogist, vol. 34, pp. 109-120, 1949

55. SHARPITE
$6UO_3.5CO_2.8H_2O$?

Composition needs to be checked

U = 73.1%

Am. Mineralogist, vol. 24, p. 658, 1939

56. SKLODOWSKITE
$Mg(UO_2)_2Si_2O_7.7H_2O$

U = 58.4%

Am. Mineralogist, vol. 10, p. 132, 1925

Chinkolobwite - synonym of sklodowskite

Am. Mineralogist, vol. 9, p. 156, 1924

57. SODDYITE
$5UO_3.2SiO_2.6H_2O$?

U = 77.0%

Mineral Abs., vol. 3, p. 371,

58. STUDTITE
A hydrated carbonate of U and Pb.

Validity of species is questionable.

Soc. belge geologie Bull., vol. 70, pp. 212-225, 1947

59. SWARTZITE
$CaMgUO_2(CO_3)_3.12H_2O$

U = 33.6%

Milton, C., U. S. Geol. Survey Personal communication

60. THORIANITE
$(Th,U)O_2$

Forms series with uraninite

U = 15.9 to 39.0%
Th = 33.7 to 81.5%

Dana VII, pp. 620-622

Uranothorianite = uranium-rich member of series

61. THORITE
$ThSiO_4$

U = up to 9.0%
Th = 25.2 to 62.7%

Dana VI, pp. 488-489

Auerlite - phosphatian variety of thorite

Th = 60.7 to 61.5%

Dana VI, pp. 488-490

Calciothorite - variety of thorite

Th = 52.3%

Dana VI, p. 489

61. THORITE (Cont.)

Enalite - uranoan thorite

U = 9.4%, Th = 25.4%

Am. Mineralogist, vol. 18, p. 223, 1933

Eucrasite - variety of thorite

Th = 31.6%

Dana VI, p. 489

Ferrothorite - a ferrian thorite

U = 2.4%, Th = 54.0%

Am. Mineralogist, vol. 14, p. 78, 1929

Freyalite - variety of thorite

Th = 25.2%

Dana VI, p. 489

Hyblite - (both alpha and beta) - hydrous basic sulfo-silicate of Th, with minor U, Fe, and Pb.

An alteration product of thorite.

Am. Mineralogist, vol. 12, pp. 368-372, 1927

Orangite - synonym of thorite

U = 1.0%, Th = 62.7%

Dana VI, pp. 488-489

Uranothorite - uranoan thorite

U = 7.4 to 13.9%
Th = 38.2 to 42.3%

Dana VI, pp. 488-489

62. THOROGUMMITE
$(Th,U)SiO_4.6H_2O$?

Compare MAITLANDITE, p. 14

U = 20.2%, Th = 36.3%

Dana VI, p. 893

Chlorothorite - synonym of thorogummite

Dana VI, p. 893

63. THOROTUNGSTITE
$3WO_3.ThO_2.4H_2O$?

Th = 14.0%

Am. Mineralogist, vol. 13, p. 159, 1928

64. TORBERNITE
$Cu(UO_2)_2(PO_4)_2.8-12H_2O$

U = 51.2 to 56.0%

Dana VI, pp. 856-857

Chalcolite - synonym of torbernite

Cuprouranite - synonym of torbernite

Metachalcolite - synonym of metatorbernite

Metatorbernite
$Cu(UO_2)_2(PO_4)_2.8H_2O$

U = 56%

Mineralog. Mag., vol. 17, pp. 326-339, 1916

Uranite = torbernite-autunite group

Dana VI, pp. 856-857

Uranophyllite - synonym of torbernite

65. TRÖGERITE
$(UO_2)_3(AsO_4)_2.12H_2O$

U = 57.5%

66. TYUYAMUNITE
$Ca(UO_2)_2(VO_4)_2.nH_2O$

n = 9-10, but may be down to 4.

U = 47.1 to 59.0%

Am. Mineralogist, vol. 12, p. 382, 1927

Calciocarnotite - synonym of tyuyamunite

Ferghanite - probably identical with tyuyamunite but original descriptions indicate minerals may be different.

Frondel, C., Harvard University
Personal communication

67. URACONITE
Hydrous sulfate of U and Cu.

U = 61.0%

Dana VI, p. 978

Uranocher - synonym of uraconite

68. URANINITE
UO_2 (between UO_2 and U_3O_8, with U^4 predominant)

U = 46.4 to 97.6%
Th = up to 12.2%

Dana VII, pp. 611-620

Bröggerite
Thorian uraninite $(U,Th)O_2$

U = 68.3%, Th = 5.3%

Dana VII, pp. 611-614

Cleveite - uraninite with rare earths

U = 57.0%, Th = 4.0%

Dana VII, pp. 611, 613-614

68. URANINITE (Cont.)

Coracite - synonym of uraninite

Dana VII, pp. 611, 615, 617

Masturan - synonym of pitchblende

Dana VII, pp. 611, 614, 617

Nivenite - uraninite with rare earths

U = 57.8%, Th = 5.9%

Dana VII, pp. 611, 613-615, 617

Pitchblende - colloform and massive uraninite

U = 56.9 to 82.9%

Dana VII, pp. 611-619

Ulrichite - synonym of uraninite

Dana VII, pp. 611, 613, 617

Uranoniobite - synonym of uraninite

Dana VII, pp. 611, 613

"Uranopissite" - synonym of uraninite

69. URANOCIRCITE
$Ba(UO_2)_2(PO_4)_2.8H_2O$

Barium analogue of autunite

U = 51.3%

Dana VI, p. 859

70. URANOPHANE
$Ca(UO_2)_2Si_2O_7.6H_2O$

U = 48.1 to 60.4%

Dana VI, p. 699

70. URANOPHANE (Cont.)

Beta-uranophane - polymorph of uranophane

Nováček, R., Vestník Královské České Spol., article VII, pp. 1-36, 1935

Lambertite - synonym of uranophane

Am. Mineralogist, vol. 11, pp. 155-157, 1926

Randite - a mixture of beta-uranophane, some tyuyamunite, and calcite.

Frondel, C., Harvard University
Personal communication

Uranotil - synonym of uranophane

U = 56.7 to 60.2%

Dana VI, p. 699

71. URANOPILITE
$U_6(SO_4)O_{17}.16(or\ 17)H_2O$

U = 69.6 to 69.9%

Beta-uranopilite
$6UO_3.SO_3.10H_2O$

Nováček, R., Vestník Královské České Spol., article VII, pp. 1-36, 1935

72. URANOSPATHITE
Hydrated uranyl phosphate?

Composition unknown

Mineralog. Mag., vol. 17, pp. 221-236, 1915

73. URANOSPHAERITE
$Bi_2U_2O_9 \cdot 3H_2O$

U = 45.9 to 43.3%

Dana VII, p. 631

74. URANOSPINITE
$Ca(UO_2)_2(AsO_4)_2 \cdot 8\text{-}12H_2O$

U = 53.4%

Dana VI, pp. 858-859

75. UVANITE
$2UO_3 \cdot 3V_2O_5 \cdot 15H_2O$

U = 32.9%

Mineralog. Mag., vol. 17, p. 359, 1916
Washington Acad. Sci. Jour., vol. 4, p. 576, 1914

76. VANDENBRANDEITE
$CuUO_4 \cdot 2H_2O$

U = 63.5 to 64.3%

Dana VII, pp. 632-633

Uranolepidite - synonym of vandenbrandeite

Am. Mineralogist, vol. 19, pp. 235-236, 1934

77. VANDENDRIESSCHEITE
Hydrous lead uranium oxide.

Validity of species is questionable.

Soc. belge geologie Bull., vol. 70, pp. 212-225, 1947

78. VOGLITE
$Cu(UO_2)(CO_3)_2 \cdot 10H_2O$?

U = 34.7%

Dana VI, p. 308

79. WALPURGITE
$Bi_4UAs_2O_{14} \cdot 3H_2O$

U = 13.5 to 17.0%

Dana VI, p. 860

Neues Jahrb., 44, Abt. A, 1948, Evans, H. T.
Personal communication, 1949

80. ZEUNERITE
$Cu(UO_2)_2(AsO_4)_2 \cdot 8H_2O$

U = 50.4%

Dana VI, p. 857

81. ZIPPEITE
$2UO_3 \cdot SO_3 \cdot 5\text{-}6H_2O$

U = 64.9 to 67.4%

Dana VI, p. 978

GROUP B. MINERALS WITH MINOR AMOUNTS OF URANIUM AND THORIUM

1. ALLANITE
$(Ca,Ce,Th)_2(Al,Fe,Mg)_3Si_3O_{12}(OH)$

U = 0.017%, Th = up to 3.2%

Dana VI, pp. 522-526

Magatelite - phosphatian variety of allanite

Th = 0.8%

Am. Mineralogist, vol. 16, pp. 343-344, 1931

Orthite - synonym of allanite

Yttro-orthite (also, yttrium orthite) - synonym of allanite

Mineralog. Mag., vol. 23, p. 639, 1934

2. ANTHRAXOLITE
A hydrocarbon, nickeliferous and uraniferous; compare kolm and thucolite.

U = 0.0029%

Am. Mineralogist, vol. 19, pp. 426-428, 1934

Asphaltite, broggite, and carburan are similar materials

3. BASTNAESITE
$(Ce,La)FCO_3$

U and Th present but less than 1%.

U. S. Geol. Survey, manuscript report

Dana VI, p. 291

4. CAPPELENITE
$(Ba,Y)_2SiBO_6$

Th = 0.42%

Dana VI, pp. 413-414

5. CERITE
Ce_2SiO_5

U = 0.4%, Th = 0.3%

Am. Mineralogist, vol. 25, pp. 381-404, 1940

6. CHINGLUSUITE
A complex silicate of Na, Mn, Ca, and Ti.

Th = 0.05%

Acad. Sci. URSS Bull., pp. 153-157, 1938

7. CORDYLITE
$Ce_2BaF(CO_3)_3$

Th = up to 0.27%

Dana VI, appendix II, p. 31

8. CORVUSITE
$V_2O_4.6V_2O_5.xH_2O$?

Validity of species is questionable.

U = 1.0 to 2.8%

Am. Mineralogist, vol. 18, pp. 195-205, 1933

9. DAVIDITE
Contains Ti, Fe, rare earths, U, V, and Cr.

U = 8.1%, Th = 0.12%

Dana VII, p. 542

Royal Soc. S. Australia Trans., vol. 68, p. 334, 1944

10. PERSMITE
$(Ca,Ce,Na)(Cb,Ti,Fe,Al)_2(O,OH,F)_6$

Th = 0.42%

Acad. Sci. URSS, Comptes rendus, 52, pp. 69-71, 1946

11. HJELMITE
AB_2O_6 or $A_2B_3O_{10}$

Also hjelmite.

A = Y,Fe^2,U^4,Mn,Ca
B = Cb,Ta,Sn,W

U = 4.0 to 4.3%

Dana VII, pp. 779-780

12. HOKUTOLITE
Variety of barite. Radioactive mixture of Pb and Ba sulfate. Probably contains Ra,Th, and U.

Mineralog. Mag., vol. 16, p. 362, 1913

Anglesobarite - synonym of hokutolite

13. JOHNSTRUPITE
A complex silicate of Na,Ca, Th,Ce, and Ti.

Th = 0.7%

Dana VI, pp. 720-721

14. KOLM
Rock with hydrocarbon and uranium.

Form in which uranium is present is unknown.

U = 0.44%

Am. Chem. Soc. Jour., vol. 52, pp. 4848-4851, 1930

See also anthraxolite and thucolite.

15. LOVOZERITE
Complex silicate of Ti and Zr.

Th = 0.50%

Acad. Sci. URSS, Comptes rendus, 25, p. 735, 1939

16. MELANOCERITE
Chiefly a boro-silicate of the Ce and Y metals.

Th = 1.5%

Dana VI, pp. 414-415

Caryocerite - near melanocerite

Th = 12.0%

Dana VI, p. 415

17. MICROLITE
$(Na,Ca)_2(Ta,Cb)O_6(O,OH,F)$

In pyrochlore-microlite series.

U = up to 5.1%, Th = 0.2%

Dana VII, pp. 748-754

Calciotantalite - possibly a mixture of microlite and tantalite.

Dana VII, p. 787

Haddamite - synonym of microlite

Dana VII, p. 748

Metasimpsonite - an alteration product of simpsonite, later identified with microlite.

Dana VII, p. 755

Neotantalite - an altered microlite with composition close to tantalite.

U = tr.

Dana VII, pp. 748, 750-751, 753

18. MOSANDRITE
Complex silicate of Na,Ca,Ce, and Ti.

Th = 0.3%

Dana VI, pp. 721-722

Also, Zentralbl. Min. A, pp. 76-79, 1934

19. PISEKITE
Essentially a columbate-tantalate-titanate of U and rare earths, with Th and Sn. No quantitative analysis available. May be related to ampangabeite.

Dana VII, pp. 807-808

20. PYROCHLORE
$(Na,Ca)_2(Cb,Ta)_2O_6F$

In pyrochlore-microlite series.

U = up to 14.0%
Th = up to 4.4%

Dana VII, pp. 748-754

Azorite - synonym of pyrochlore

Chalcolamprite - synonym of pyrochlore

Dana VII, pp. 748, 750, 754

Ellsworthite - composition is close to pyrochlore, but analyses show it is relatively high in U and H_2O and low in alkalies.

U = 17.1%

Dana VII, pp. 748, 750-752

20. PYROCHLORE (Cont.)

Endeiolite - similar in composition to chalcolamprite.

An altered pyrochlore?

Dana VII, pp. 748, 754

Hatchettolite - uranian pyrochlore

U = 14.0%, Th = 0.5%

Dana VII, pp. 748, 750-752

Koppite - synonym of pyrochlore

Dana VII, pp. 748, 750, 752

Marignacite - synonym of pyrochlore

Th = 0.2%

Dana VII, pp. 748, 750-752

Pyrrhite - synonym of pyrochlore

Dana VII, pp. 748, 752, 754

21. RINKITE
Complex silicate of Na,Ca, Ce, and Ti.

Th = small amounts

Dana VI, p. 722

Kondrikite - a mixture of rinkite and zeolite

Lovchorrite - alteration product of rinkite?

U = up to 0.01%

Th = up to 0.7%

Vudyavrite - alteration product of rinkite.

Th = about 1%

22. RINKOLITE
Complex silicate of Na,Ca,Ce, and Zr.

Th = up to 0.41%

Am. Mineralogist, vol. 11, p. 289, 1926

Acad. Sci., URSS Bull. 20, p. 1181, 1926

23. ROWLANDITE
An yttrium silicate.

U = 0.4%

Dana VI, p. 1047

24. STEENSTRUPINE
Complex silicate of rare earths, Th,Na,K,Fe,Mn,Mg, P,Be,Al, and Ta, with (OH) and F.

Th = 6.2%

Dana VI, p. 415

Also, Neues Jahrb., Beilage-Band 64, Abt. A, pp. 235-249, 1931

25. TCHEFFKINITE
Complex silicate of rare earths, Fe,Mn,Mg,Ca,Al,Ti, Th, and U.

Also chevkinite

U = 2.3%, Th = up to 18.4%

Am. Mineralogist, vol. 31, pp. 582-588, 1946

26. TENGERITE
$CaY_3(CO_3)_4(OH)_3.3H_2O$?

Alteration product of yttrialite.

Th = 0.3%

Sci. Papers Inst. Phys. Chem. Res. (Tokyo), vol. 34, pp. 832-841, 1938

26. TENGERITE (Cont.)

The originally described tengerite, Dana VI, pp. 306-307, is a different mineral, supposedly beryllium yttrium carbonate; no published analysis.

27. THALENITE
$Y_4Si_4O_{13}(OH)_2$

Related to yttrialite.

Th = 0.16%

Dana VI, appendix I, p. 68

28. THUCOLITE
A hydrocarbon.

See kolm and anthraxolite.

U = 4.9%, Th = 42.5% - these percentages are from the ash which is only about 1 percent by weight of total material.

Am. Mineralogist, vol. 13, pp. 419-448, 1928

29. TRITOMITE
A boro-silicate of the cerium and yttrium metals, calcium, and thorium, also containing fluorine. Exact formula uncertain.

Th = 7.5 to 8.3%

Dana VI, p. 416

30. TURANITE
A hydrated copper vanadate of dubious validity reported to contain 3.2% U.

Acad. Sci. St. Pétersbourg, Bull. 3, p. 185, 1909

31. VANOXITE
A hydrated vanadium oxide, perhaps $2V_2O_4.V_2O_5.8H_2O$, reported to contain up to 0.5% U.

U. S. Geol. Survey Bull. 750, . 63 1924

32. VOLBORTHITE
$(Cu,Ca)_2(VO_4)(OH)$

U = 3.1%

Nenadkevich and Volkov, C. R., Acad. Sci., URSS, 43, 1926

Calciovolborthite
Calcium end-member in volborthite series.

Nenadkevich and Volkov, C. R., Acad. Sci., URSS, 43, 1926

33. WIIKITE
Ill-defined mixture and alteration product of minerals high in Cb,Ta,Ti,Si, and Y.

Dana VII, p. 801

Nuolaite
A mixture similar to wiikite.

Th = 1.8 to 3.5%

Dana VII, p. 801

34. XENOTIME
YPO_4

U = up to 3.6%
Th = 0.4 to 2.9%

Dana VI, pp. 748-749

35. YTTRIALITE
Silicate of Th and Y metals chiefly.

U = 0.8%, Th = 10.5%

Dana VI, p. 512

36. YTTROCRASITE
$(Y,Th,U,Ca)_2(Ti)_4O_{11}$?

U = 2.3%, Th = 7.7%

Dana VII, p. 793

37. YTTROTANTALITE
$(Fe,Y,U)(Cb,Ta)O_4$

U = 3.4 to 3.9%
Th = 0.6 to 0.7%

Dana VI, pp. 763-764

Yttrocolumbite is similar

Am. Mineralogist, vol. 25, p. 155, 1940

38. ZIRCON
$ZrSiO_4$

U and Th very low in most samples, but up to 2.7% U, and up to 13.1% Th reported.

Dana VI, pp. 482-486

Alvite
Variety of zircon, near cyrtolite.

Th = 13.1%?

Dana VI, pp. 487-488

Calyptolite
Probably altered zircon.

Dana VI, pp. 482, 486

Cyrtolite
Altered zircon, containing U, Th, Y, and other rare earths.

U = up to 1.4%

Dana VI, p. 487

Hagatalite - synonym of zircon

U = tr., Th = 1.3%

Am. Mineralogist, vol. 11, p. 137, 1926

38. ZIRCON (Cont.)

Hoegtveitite
May be alvite.

Am. Mineralogist, vol. 12,
p. 97, 1927

Naegite - synonym of zircon

U = 2.4 to 2.7%
Th = 2.5 to 4.4%

Chem. Soc. Japan Jour.,
vol. 42, p. 1, 1921

Also, Mineral Abs., vol. 2,
p. 36, 1923

Oerstedite
Altered zircon.

Dana VI, p. 486

Oyamalite - synonym of zircon

Th = 0.5%

Am. Mineralogist, vol. 11,
pp. 137-138, 1926

Tachyaphaltite
Probably altered zircon.

Dana VI, p. 486

Yamagutilite - synonym of zircon

Also, yamaguchilite

Contains P_2O_5 and rare earths.

Mineralog. Mag., vol. 24,
p. 626, 1937

39. ZIRKELITE
$(Ca,Fe,Th,U)_2(Ti,Zr)_2O_5$?

U = 1.4%, Th = 6.4%

Dana VII, p. 740

GROUP C. MINERALS WHICH SHOULD BE TESTED FOR URANIUM AND THORIUM

1. ABUKUMALITE
CaY phosphate silicate

Am. Mineralogist, vol. 24, p. 66, 1939

2. AMBATOARINITE
Carbonate of Sr and rare earths.

Mineral Abs., vol. 1, p. 148, 1920

3. ANCYLITE
$Sr_3Ce_4(CO_3)_7(OH).3H_2O$?

Dana VI, appendix II, pp. 5-6

Weibyite
Related to ancylite

Dana VI, pp. 291-292

4. BAZZITE
Silicate of scandium, with Fe, Na, and rare earths.

Mineral Abs., vol. 8, p. 105, 1941

5. BECKELITE
$Ca_3(Ce,La,Pr,Nd)_4Si_3O_{15}$

Dana VI, appendix II, p. 14

6. BRITHOLITE
A cerium-silicate apatite?

Dana VI, appendix II, pp. 19-20

7. BUSZITE
Silicate of rare earths

Am. Mineralogist, vol. 14, pp. 438-439, 1929

8. CENOSITE
$2CaO.(Ce,Y)_2O_3.CO_2.4SiO_2.H_2O$?

Also kainosite

Am. Mineralogist, vol. 15, pp. 205-219, 1930

9. CHURCHITE
A hydrous phosphate of cerium and calcium.

Dana VI, p. 820

10. ERDMANNITE
Hydrous silicate of Ce, Y,Fe,Mn,Al, and Ca.

A mixture of homilite with a mineral in the melanocerite group?

Dana VI, pp. 416, 507

11. ERIKITE
Phosphate-silicate of rare earths, Al, Ca, and Na.

Mineralog. Mag., vol. 14, p. 348, 1907

12. EUDIALYTE
$X_5Y_2Si_6O_{18}(OH,Cl)$

X = Ca, Na, Ce, etc.

Y = Zr, Fe, Cb, etc.

Dana VI, pp. 409-412

Eucolite
Same as eudialyte, but with different optical sign.

Dana VI, pp. 409-412

13. FLORENCITE
$CeAl_3(PO_4)_2(OH)_6$

Dana VI, appendix II, p. 42

14. FLUOCERITE
$(Ce,La)F_3$

Am. Mineralogist, vol. 6, p. 119, 1921

Tysonite = fluocerite

Dana VI, p. 166

15. GADOLINITE
$Be_2FeY_4Si_2O_{13}$

Dana VI, pp. 509-512

16. HELLANDITE
$Ca_2(Ce,Al,Mn)_6Si_4O_{19}\cdot 3H_2O$

Mineralog. Mag., vol. 13, p. 368, 1903

17. LANTHANITE
$La_2(CO_3)_2\cdot 9H_2O$

Dana VI, pp. 302-303, also Dana V, p. 710

18. LESSINGITE
Silicate of the rare earths.

Mineral Abs., vol. 10, p. 245, 1948

19. LORANDITE
$(Y,Ce,Ca)(Ta,Zr)O_4$?

Dana VII, p. 767

20. MURITE
Titano-columbate of Y, Fe, and Ta.

Validity of species is questionable.

Am. Mineralogist, vol. 32, pp. 204-205, 1947

21. PARISITE
$CaCe_2F_2(CO_3)_3$?

Dana VI, pp. 290-291

21. PARISITE (Cont.)

Synchisite
$CaCeF(CO_3)_2$

Related to parisite.

Mineralog. Mag., vol. 13, pp. 207-208, 1902

22. PEROVSKITE GROUP

Perovskite
$CaTiO_3$ - some analyses show rare earths.

Dana VII, pp. 730-734

Dysanalyte - synonym of perovskite; analysis shows rare earths.

Dana VII, pp. 730-732

Knopite - in perovskite group

Analysis shows rare earths.

Dana VII, pp. 730-733

Loparite - end member in perovskite-knopite-loparite series.

Perhaps $(Na,Ce,Ca)_2(Ti,Cb)_2O_6$

Dana VII, pp. 730, 732-734

23. RETZIAN
Basic arsenate of Mn, Cu, and rare earths.

Dana VI, appendix I, p. 59

24. RHABDOPHANITE
Hydrous phosphate of Ce and Y groups; perhaps $(Ce,Y)PO_4\cdot H_2O$

Also rhabdophane

Dana VI, p. 820

24. RHABDOPHANITE (Cont.)

Scovillite - synonym of rhabdophanite

Dana VI, p. 820

25. SCHETELIGITE
$(Ca,Y,Sb,Mn)_2(Ti,Ta,Cb)_2(O,OH)_7$

Dana VII, p. 757

26. SPHENE
Essentially $CaTiSi_2O_5$, but commonly contains rare earths, columbium, and other elements.

Am. Mineralogist, vol. 32, pp. 637-642, 1947

Keilhauite = yttrian sphene

Dana VI, p. 717

Yttrotitanite - synonym of keilhauite

27. THORTVEITITE
$(Sc,Y)_2Si_2O_7$

Am. Mineralogist, vol. 7, pp. 195-196, 1922

Befanamite - synonym of thortveitite

Am. Mineralogist, vol. 11, p. 137, 1926

28. TORNEBOHMITE
Chiefly $R_3(F,OH)(SiO_4)_2$

R = Ce,(La,Nd),Al,Fe,Mn,Mg,Ca

Am. Mineralogist, vol. 6, pp. 118-119, 1921

29. WEINSCHENKITE
$YPO_4.2H_2O$

Am. Mineralogist, vol. 29, pp. 97-107, 1944

GROUP D. MINERALS WHICH ARE NON-URANIUM- OR NON-THORIUM-BEARING, BUT WHICH HAVE BEEN REPORTED TO CONTAIN IMPURITIES OR INTERGROWTHS OF URANIUM, THORIUM, OR RARE-EARTH MINERALS

1. BADDELEYITE
ZrO_2

Analyses show traces of rare earths.

Dana VII, pp. 607-610

Brasilite - mixture of fibrous baddeleyite, zircon, altered zircon, and other minerals.

Dana VII, p. 610

Caldasite - mixture of baddeleyite, zircon, altered zircon, and other minerals.

Dana VII, p. 610

Zirkite - mixture of baddeleyite, zircon, altered zircon and other minerals.

2. COLUMBITE-TANTALITE SERIES

Columbite
$(Fe,Mn)(Cb,Ta)_2O_6$

U = up to 1.7%

Dana VII, pp. 780-785

Baierite - synonym of columbite

Also baierine

Dana VII, p. 780

Dianite - synonym of columbite

Dana VII, p. 780

2. COLUMBITE-TANTALITE SERIES (Cont.)

Ferrocolumbite - synonym of columbite

Dana VII, pp. 780, 783

Ferro-ilmenite - synonym of columbite

Dana VII, pp. 780, 785

Ferrotantalite - synonym of tantalite

Dana VII, pp. 780, 783

Greenlandite - synonym of columbite

Dana VII, pp. 780, 784

Hermannolite - synonym of columbite

Dana VII, pp. 780, 785

Ildefonsite - synonym of tantalite

Dana VII, p. 780

Manganocolumbite - variety of columbite

Dana VII, pp. 780, 783, 785

Manganotantalite - synonym of tantalite

Dana VII, pp. 780, 783-784

Siderotantalite - synonym of tantalite

Dana VII, p. 780

Tantalite
$(Fe,Mn)(Ta,Cb)_2O_6$

3. FLUORITE
CaF_2

Some samples, especially those of deep-purple color, show radioactivity. This generally can be shown to be due to inclusions of uranium minerals, but the fluorite itself may possibly contain traces of uranium.

Dana VI, pp. 161-164

Yttrocerite
CaF_2 with varying amounts of $(Y,Ce)F_3$.

Dana VI, p. 182

Yttrofluorite - yttrian variety of fluorite

Mineralog. Mag., vol. 16, p. 376, 1913

4. FRANCOLITE
An apatite which is an important constituent of many phosphate rocks, but which analyses show contain very little rare earths.

Dana VI, pp. 762, 764

5. ILMENORUTILE
Columbian rutile.

Dana VII, pp. 554, 557, 560

6. KALKOWSKITE
$Fe_2Ti_3O_9$?

Analysis shows rare earths.

Dana VII, pp. 773-774

7. KATANGITE
$H_2CuSiO_4 + H_2O$?

Is identical with chrysocolla; found together with uranium minerals in Katanga, Belgian Congo.

Am. Mineralogist, vol. 8, p. 39, 1923

8. OPAL
$SiO_2.nH_2O$

Some varieties show green fluorescence due to uranium content.

9. PYROMORPHITE
$Pb_5(PO_4)_3Cl$

Some specimens are uraniferous.

Zeitschr. Kristallographie, vol. 62, pp. 177-178, 1925

10. SCAPOLITE
$(Na,Ca)_4Al_3(Al,Si)_3Si_6O_{24}(Cl,CO_3,SO_4)$

A fluorescent variety contains 0.023% U.

Chemie der Erde, vol. 9, pp. 139-144, 1934-35

11. SEFSTROMITE
Mixture largely of ilmenite, similar to davidite.

Dana VII, p. 542

12. STRUEVERITE
Tantalian rutile.

Dana VII, pp. 554, 557-560

13. TAPIOLITE SERIES

Cassiterotantalite - synonym of ixiolite

Dana VII, p. 778

Ixiolite - may be equal to tapiolite

Dana VII, p. 778

Ixionolite - synonym of ixiolite

Mossite
$Fe(Cb,Ta)_2O_6$

Dana VII, pp. 775-777

13. TAPIOLITE SERIES (Cont.)

Skogbölite - synonym of tapiolite

Dana VII, pp. 775-778

Tapiolite
$FeTa_2O_6$

Dana VII, pp. 775-777