AN OUTLINE OF THE ULTRABASICOSAXICOLOUS FLORA OF HOKKAIDO, JAPAN (1)

By

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(With 1 Plate, 2 Tables and 1 Text-figure)

I. Introduction

It has long been known that peculiar plants are met with richly in the areas of certain kinds of rocks or of their degraded soils as compared with those in surrounding areas. For example, so early as in 1836, UNGER noticed peculiar plants growing in the limestone area, while in 1859 PANČIČ reported the characteristic plants in the ultrabasic rock area.

In Japan, however, an appearance of such works was much delayed in comparison with the European ones, but Tomitaro MAKINO and Hisayoshi TAKEDA, respectively, noticed the relation between limestone areas and peculiar plants growing there during the period of the early 20th. Torama YOSHINAGA published in 1914 a paper entitled "The relation between serpentinites and peculiar plants in Tosa", which was the first report on such a theme in Japan.

In Hokkaido, contrary to the much limited small limestone areas, the ultrabasic rock areas are much abundant along the central tectonic line, and there are many broad and wide outcrops in these areas. Already in 1918, Shozo NISHIDA reported in detail the peculiar plants growing on serpentinites and their degraded soils in Mt. Yupari in his paper, "On the distribution of plants in the Yubari Mountain Range". Misao TATEWAKI was quick to check almost all ultrabasic rock areas in Hokkaido botanically; in 1927 he reported the relation between the ultrabasic rocks and plant distribution, publishing 2 papers, in 1928 he made florulas of Mt. Apoi, Prov. Hidaka and the Teshio Experimental Forest of Hokkaido University, in both of which large ultrabasic rock areas are included, and in 1932 he also reported the florula of the Uryu Experimental Forest of Hokkaido University. As the results of his efforts, he published one after another reliable florulas of ultrabasic rock areas in Hokkaido.

After the World War II, Shiro KITAMURA, Minosuke HIROE and the present writer have investigated ultrabasicosaxicolous floras of Hokkaido, and consecutively Toru MISUMI, Tsuneo IGARASHI, Sadamoto WATANABE, Shoichi KAWANO, Shiro

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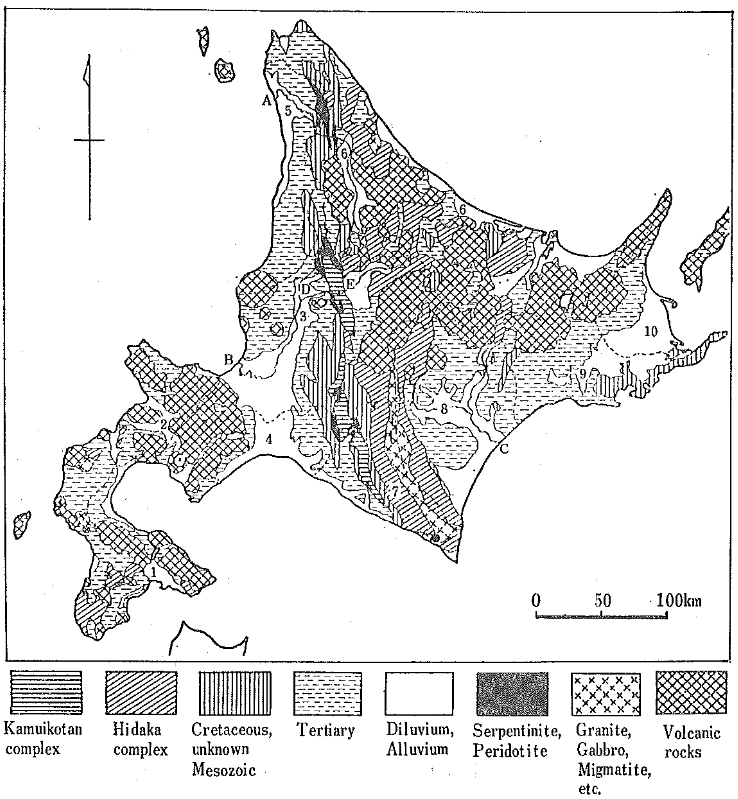
NOSAKA and others have noticed ultrabasic rock areas of Hokkaido from the phytogeographical as well as the phytotaxonomical standpoints, while Kan'ichi INAGAKI and his students have exclusively dealt botanically with the ultrabasic rock areas of central and northern Hokkaido.

II. General Aspect of the Ultrabasic Rock Areas of Hokkaido

The ultrabasic rock areas in Hokkaido are met with in the axial belts of the Hidaka orogenic zone extending from Esashi, Kitami Province southwards to the cape of Erimo, Hidaka Province, as well as in the Kamuikotan metamorphic zone which is located in the west of the above-mentioned Hidaka orogenic zone running parallel to that. Most parts of the ultrabasic rock areas belonging to the Kamuikotan formation are represented by serpentinites, while those belonging to the Hidaka formation are in most parts still young showing peridotitic nature.



Provinces : 1. Oshima, 2. Shiribeshi, 3. Ishikari, 4. Iburi, 5. Teshio, 6. Kitami, 7. Hidaka, 8. Tokachi, 9. Kushiro and 10. Nemuro.

Rivers : A. The Teshio R., B. The Ishikari R., C. The Tokachi R., D. The Uryu R., and E. The Kamuikotan Valley.

Fig. 1. Geological Sketch Map of Hokkaido (after J. SUZUKI 1952)

The serpentinite areas belonging to the Kamuikotan complex are developed in rather disjunctively located 3 areas : the northernmost one is along the Nupromapporo River, Toikambetsu ; that extends about 45km from north to south, and about 10km from east to west, being the largest of all the ultrabasic rock areas of Hokkaido, the second one, the Uryu Mountainland is placed about 40km south from the above serpentinite area, and it has a length of ca. 43km and a width of ca. 10km, and the third or last one is locateed further south and about 90km from the second one, and this area is called "the Yupari-Yufutsu-Saru serpentinite area", of which outcrops consist of 3 distinct irregularly shaped ones : they measure 25km×4km, 18km ×4km, and 15km×6km, respectively. Moreover, there develop numerous but very small serpentinite outcrops in the Kamuikotan metamorphic zone parallel to its longer axis. On other hand, peridotitic areas are exclusively seen in the Hidaka complex : in the northern part, there is encountered a belt-like peridotitic area from Mt. Tottabetsu southwards through Mt. Porojiri to Mt. Nishi-Chiroro, while in the southern, there is a complex peridotitic area on Mt. Horoman and Mt. Apoi, which measures about 10km in diameter.

The ultrabasic rock areas of Hokkaido are shown in the geological sketch map (Fig. 1).

III. Classification of Plants in the Ultrabasic Rock Area

Among igneous rocks, ultrabasic rocks such as serpentinites, peridotites, etc. are formed from the basic rock which contains smaller amounts of silicates by means of metamorphosis, and they become to contain less than 45% of silicates and more than 30% of magnesium oxides, their degraded soils showing acidic nature. Chemical compositions of serpentinites and peridotites are shown in Tables I and II. In general, degraded soils derived from ultrabasic socks contain high quantities of such a heavy metal as magnesium, being toxic and having less nutrients for plants compared with the soils of another origin. On the other hand, limestones have much amounts of calcium carbonates, and their degraded soils show alkalinity. Among plants, there are the ones that appear on ultrabasic rocks and limestones, simultaneously. In such a case, the plants are often proved to be relics of the Ice Age. *Rhamnus ishidae* is a good example in this respect. As for such a plant, it seems to be less important in the acidity or the alkalinity of the soils on which it grows, and the more important ones are to be the physical conditions of localities against plants common to ultrabasic rock and limestone areas.

Various systems of classification for plants occurring in ultrabasic rock areas have been proposed by different authors (cf. RUNE 1953, INAGAKI *et al.* 1968). The system employed here is the one proposed by the author (INAGAKI *et al.* 1968, with

TABLE I. Chemical Compositions of Serpentinites from Hokkaido

	1	2	3	4	5	6
SiO_2	33.39	39.37	39.87	37.29	38.45	53.09
TiO_2	—	—	—	—	—	1.30
Al_2O_3	1.45	0.99	1.00	8.38	3.24	0.89
Fe_2O_3	2.94	5.17	5.24	7.23	3.26	5.42
FeO	5.60	3.77	3.82	2.23	5.16	4.46
MnO	—	—	—	—	—	0.28
MgO	37.84	35.61	36.06	28.20	36.32	20.98
CaO	0.52	0.28	0.28	0.43	0.87	10.49
Na_2O	—	—	—	—	0.25	0.53
K_2O	—	—	—	—	—	0.06
$H_2O(+)$	—	13.56	13.73	12.37	—	—
$H_2O(-)$	—	1.19	—	3.32	—	—
Ign. loss	12.79	—	—	—	12.53	3.04
Total	100.53	99.94	100.00	99.45	100.08	100.54

(1) Serpentinite. Kishinosawa, Yamabe district, Ishikari Prov. (in Hidaka complex) Anal. H. KONISHI (SUZUKI 1941)
(2) Serpentinite. Sakaezawa, Yamabe district, Ishikari Prov. (in Hidaka complex) Anal. T. INOUE (SUZUKI 1952)
(3) Serpentinite. country rock of chrysotile vein at the Nozawa mine, Yamabe district, Ishikari Prov. Anal. T. INOUF. (SUZUKI and INOUE 1948)
(4) Serpentinite. Near Kanayama, Sorachi-gun, Ishikari Prov. (in Hidaka complex) Anal. M. SAMBONSUGI (SUZUKI 1952)
(5) Serpentinite. Takadomari, Uryu-gun, Ishikari Prov. (in Kamuikotan complex) Anal. A. KANNARI (SUZUKI 1939)
(6) Actinolite-fels. Horokanai-pass, Uryu-gun, Ishikari Prov. (in Kamuikotan complex) Anal. A. KANNARI (SUZUKI 1939)

a slight modification), and all the plants that occur in ultrabasic rock areas are to be classified as follows :

A. Ultrabasicosaxicolous plants (i. e., Ultrabasic rock characteristic plants)
  a. Typical ultrabasicosaxophytes
  b. Preferential ultrabasicosaxophytes
  c. Ultrabasicosaxicolous relics
B. Ultrabasic rock ubiquists
C. Ultrabasic rock indifferent plants
D. Ultrabasic rock accidental plants

Since 1955, the writer has proposed the use of the term "ultrabasicosaxicolous plants" for the characteristic plants that appear in ultrabasic rock areas, instead of the historically long used term "serpentine plants", and his proposal has gradually been accepted (*e. g.*, NOSAKA 1974). In addition to this proposal, WATANABE in 1971 proposed to use the term "diabasic plants" for the plants occurring on diabasic rocks, and the writer agrees with WATANABE's view. In this paper, therefore, the

TABLE II. Chemical Compositions of Peridotites from Hokkaido

	1	2	3	4	5	6	7	8
SiO_2	39.31	42.16	40.20	40.86	43.28	39.82	42.16	43.12
TiO_2	—	tr	tr	tr	0.03	—	—	—
Al_2O_3	1.27	3.69	1.31	1.89	5.60	2.50	3.58	4.06
Fe_2O_3	4.37	2.72	0.86	2.59	1.72	8.52	9.48	9.35
FeO	7.27	5.13	4.13	5.54	4.77	—	—	—
MnO	n.d.	0.43	0.38	tr	0.46	—	—	—
MgO	38.89	38.69	45.81	45.15	32.80	46.65	40.25	40.01
CaO	6.52	5.38	4.96	2.72	9.56	0.20	0.50	0.96
Na_2O	0.14	0.58	n.d.	—	0.50	—	—	—
K_2O	0.04	0.16	n.d.	—	0.14	—	—	—
$H_2O(+)$	1.93	0.75	0.44	0.21	0.66	0.62	0.36	—
$H_2O(-)$				0.34		0.45	1.95	0.96
CO_2	—	—	—	—	—	—	—	0.41
Cr_2O_3	—	—	—	0.17	—	0.78	0.72	0.82
NiO	—	—	—	—	—	0.35	0.38	0.30
Total	99.74	99.69	98.09	99.47	99.57	99.89	99.38	99.99

(1) Dunite. Poroshiri-Dake, Hidaka Prov. (in Hidaka complex) Anal. S. HASHIMOTO (HUNAHASI and HASHIMOTO 1951)
(2) Pyroxene dunite (A). Apoi-dake, Horoman, Hidaka Prov. in (Hidaka complex) Anal. S. ITO and T. YAMAMOTO (HUNAHASI and HASHIMOTO 1951)
(3) Pyroxene dunite (B). Apoi-dake, Horoman, Hidaka Prov. Anal. S. ITO and T. YAMAMOTO (HUNAHASI and HASHIMOTO 1951)
(4) Hornblende pyroxene dunite. Apoi-dake, Horoman, Hidaka Prov. Anal. S. ITO and T. YAMAMOTO (SUZUKI 1952)
(5) Peridotite (Gabbroic facies). Apoi-dake, Horoman, Hidaka Prov. (in Hidaka complex) Anal. S. ITO and T. YAMAMOTO (HUNAHASI and HASHIMOTO 1951)
(6) Pyroxene dunite (A). Iwanai-dake, Hidaka Prov. (in Kamuikotan complex) Anal. S. MORITA (SUZUKI 1952)
(7) Pyroxene-dunite (B). Iwanai-dake. Hidaka Prov. Anal. S. MORITA, (SUZUKI 1952)
(8) Pyroxene-dunite (C). Iwanai-dake, Hidaka Prov. Anal, S. MORITA, (SUZUKI 1952)

author excludes the description of plants occurring in the areas of diabasic rocks, green schists, etc. as observable on the Gama-iwa (toad-shaped rock) of Mt. Yupari, which he included within the description of ultrabasic rock areas in his previous paper (TOYOKUNI 1956). As for the plants occurring in the limestone areas, the term "limestone plants" should also be changed to a more general term. In this case, "calcareous rock characteristic plants" or a shorter term derived from Latin, such as "calcareosaxicolous plants" does meet this demand.

Ultrabasicosaxicolous plants or ultrabasic rock characteristic plants are those occurring more frequently or abundantly in ultrabasic rock areas than in the surrounding ones, either being of morphologically recognisable phases or being geographically isolated from their allies. This category is again divided into 3 lower groups.

Typical ultrabasicosaxophytes are morphologically recognisable taxa, appearing exclusively in ultrabasic rock areas, not being geographically isolated from related taxa. A few examples of plants belonging to this group are *Betula apoiensis*, *Viola yubariana*, *Primula yuparensis*, *Lagotis glauca* subsp. *takedana*, *Taraxacum yuparense*, *Hierochloe pluriflora*, etc.

Preferential ultrabasicosaxophytes are almost the same as above, but the plants of this group occur in ultrabasic rock areas not exclusively but preferentially. The distinction between the two groups becomes from time to time to be not so clear. *Tithymalus sieboldianus* f. *montanus*, *Angelica stenoloba*, etc. belong to this group.

Ultrabasicosaxicolus relics are plants occurring disjunctively in ultrabasic rock areas, and geographically isolated from the related taxa. The plants belonging to this group are *Arenaria katoana*, *Draba japonica*, *Crepis gymnopus*, *Saussurea chionophylla*, etc. *Rhamnus ishidae*, which was often treated as an ultrabasicosaxicolous relic, is a palaeo-endemic species in Hokkaido distributed scatteredly in both ultrabasic rock (Mt. Yupari, Mt. Tottabetsu, Mt. Apoi, etc) and limestone (Mt. Kirigishi) areas.

Ultrabasic rock ubiquists are plants in ultrabasic rock areas not appearing as morphologically recognisable taxa, and not being geographicaly isolated from the related taxa, *i. e.*, the morphologically unchanged phases derived from the ubiquitous plants of the surrounding areas. *Stellaria nipponica* var. *yezoensis*, *Thlaspi japonicum*, *Aconitum yuparense*, etc. belong to this group.

Ultrabasic rock indifferent plants are those occurring in ultrabasic rock areas at about the same rate as in other areas in the vicinity.

Ultrabasic rock accidental plants are those accidentally met with in ultrabasic rock areas.

(to be continued)

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PLATE

Fig. 2. Arenaria katoana MAKINO, an ultrabasicosaxicolous relic (Mt. Tottabetsu, Prov. Hidaka)

Fig. 3. Draba japonica MAXIMOWICZ, an ultrabasicosaxicolous relic (Mt. Tottabetsu, Prov. Hidaka)

Fig. 4. Lagotis glauca GAERTNER subsp. takedana TOYOKUNI et NOSAKA, a typical ultrabasicosaxophyte (Mt. Yupari, Prov. Ishikari)

Figs. 5 and 6. Saussurea chionophylla TAKEDA, an ultrabasicosaxicolous relic (Mt. Tottabetsu, Prov. Hidaka)

Fig. 7. Primula yuparensis TAKEDA, a typical ultrabasicosaxophyte (Mt. Yupari, Prov. Ishikari)