Field Symposium - Kamchatka -2001

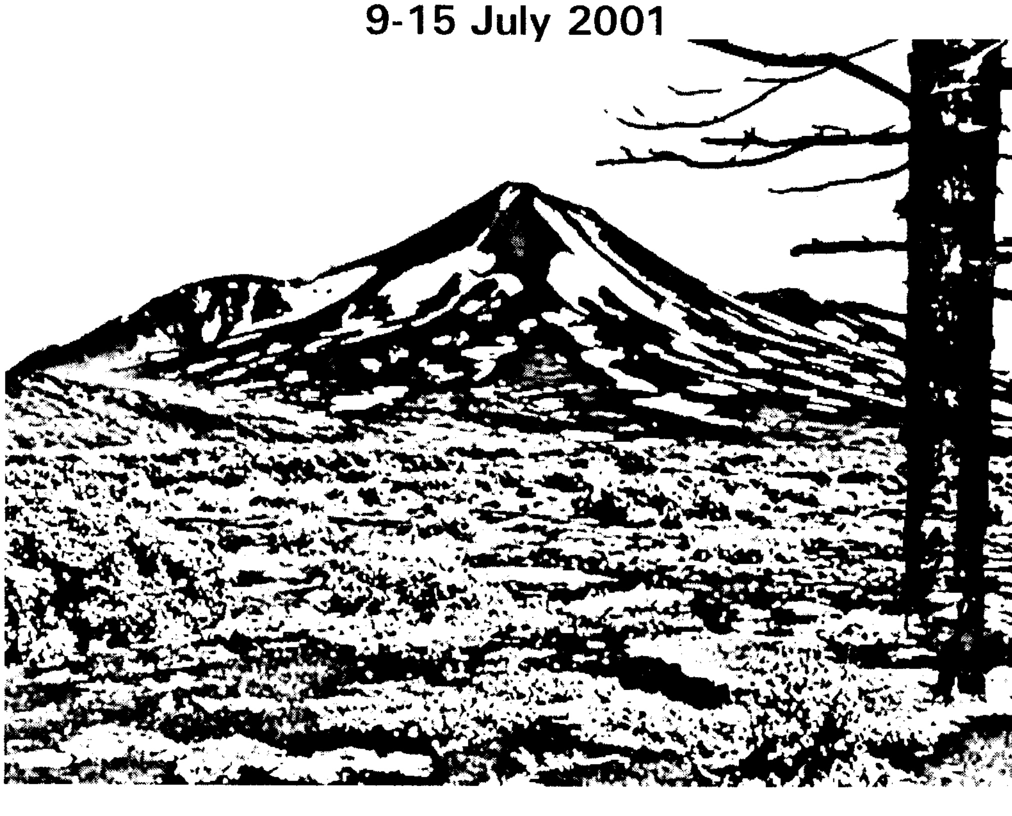
Plants
and Volcanoes

Field Symposium

Plants and Volcanoes

Abstracts

of the Kamchatka Field Symposium
"Plants and Volcanoes"
Petropavlovsk-Kamchatskiy, Russia
9-15 July 2001



Russian Academy of Sciences
Far East Branch
Institute of Biology and Soil Science

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Vladivostok 2001

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Editor P.V. Krestov

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В брошюре представлены тезисы докладов Камчатского полевого Симпозиума «Растения и Вулканы», состоявшегося в Петропавловске-Камчатском с 9 по 15 июля 2001 года.

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Institute of Volcanic Geology & Geochemistry (Petropavlovsk-Kamchatskiy)
Institute of Volcanology (Petropavlovsk-Kamchatskiy)
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Primary Succession on Salt Flats, on Sand Dunes, and on Lava Flows. Similarities in Vegetation Dynamics

S.-W. Breckle & U. Breckle

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З.В. Брекль, Ю. Брекль. Первичные сукцессии на соляных равнинах, песчаных дюнах и лавовых потоках. Сходства в динамике растительности

Terrestrial vegetation dynamics is characterized by strong competition between species. New terrestrial open surfaces, as they are formed by retreating lakes (by a huge extent around the Aral Sea), by movement of sand dunes (in many sand deserts), by retreating glaciers (along their open moraines), or by new lava flows (in many areas with active volcanism) are very fast colonized by organisms.

Primary successional stages start from input of diaspores by long distance dispersal, since by definition no seed-bank is existing. The first successional stages, thus, are characterized by organisms, able for long distance dispersal and able to colonize adverse substrates. Establishment, as the next steps, means, that under abiotic favourable conditions, rather soon competition between species starts and a sequence or various sequences of successional stages take place. The schematic sequences of primary successional stages are astonishingly similar on rather diverse substrates. Examples from very distant and differing zonobiomes are discussed: sand-dunes in the deserts of Namibia and the Negev, solonchak flats from the new (dried sea floor from the 1990s) open areas around the Aral Sea, and bare lava surfaces from lava flows and other volcanic substrates from Hawaii and Costa Rica. Similarities in respect of colonization by cyanobacteria and lichens, but especially with pioneer species of spermatophytes and differences in the successional sequences are pointed out and demonstrated by relevant coloured slides.

Colonization Dynamics and Impacts of a Nitrogen-Fixing NATIVE Shrub (*Coriaria arborea*) in Post-Volcanic Primary Succession

***Bruce D. Clarkson*[1]*, Lawrence R. Walker*[2]*, Warwick B. Silvester*[1] *and Beverley R. Clarkson*[3]**

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Б. Кларксон, Лоренц Уолкер, В. Сильвестер, Б. Кларксон. Колонизационная динамика и воздействие азотофиксирующего кустарника (*Coriaria arborea*) в поствулканической сукцессии

We examined the colonization dynamics and successional impacts of a thicket-forming actinorhizal shrub, *Coriaria arborea*, on primary succession on Mt. Tarawera, a North Island volcano that last erupted in 1886. Seed production was high but most seeds did not remain viable for >6mo. Germination was inhibited by nitrogen fertilization in indoor experiments and by the nitrogen-rich soils under Coriaria shrubs in the field but promoted by wind protection provided naturally by shrubs or by artificial barriers. Transplanted Coriaria seedlings only survived if nodulated with Frankia and Coriaria soils slowed Coriaria seedling growth and did not improve seedling survival. Therefore, establishment of Coriaria seedlings is found mostly in protected habitats where adult Coriaria are absent, suggesting that Coriaria thickets are not self-replacing. Coriaria thickets increased soil fertility by increasing leaf litter depth (3-fold over a pre-Coriaria stage dominated by herbs), SOM (40-fold), TKN (20-fold), P (2-fold), CEC (4-fold), Ca (8-fold), K (3-fold), and Mg (5-fold). These soil changes resulted in 3-6 fold increases in growth, seedling height, leaf number, and biomass of glass house potted Griselinia, a later successional tree on Mt. Tarawera. Where frost prevents Coriaria establishment, mosses and Dracophyllum shrubs that are adapted to low nutrient levels dominate succession. We suggest Coriaria on Mt. Tarawera provides a classic example of a nitrogen-fixer facilitating primary succession, and that it can be considered either a key or keystone species in this setting.

The Mosses of Kochelevsky Volcano

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И.В.Чернядьева. Мхи вулкана Кошелевский

Kochelevsky Volcano is situated at the territory of South-Kamchatka Reserve (South of the Kamchatka Peninsula). The flora of Kochelevsky Volcano includes 129 species of mosses. In the lower slopes of volcano 30 species of mosses grow in alder shrubs (abundant *Brachythecium reflexum, Ptilium crista-castrensis*), 24 species – in Siberian dwarf-pine elfin woods (abundant *Pleurozium schreberi, Dicranum majus*), 42 species – in tundra short-grass meadow (abundant *Hylocomium pyrenaicum, H. splendens*). In the upper slopes and on the border of crater 48 mosses grow in the mountain tundra (dominant *Dicranum angustum, Racomitrium lanuginosum, Polytrichum hyperboreum*), 52 mosses – in snow-patch communities (abundant *Sanionia uncinata, Philonotis fontana*). At the territory of hot springs (on the slope of volcano and in the crater) 60 species of mosses were collected (typical *Dicranella heteromalla, Warnstorfia pseudostraminea*). 77 mosses were recorded on the banks of streams (abundant *Brachythecium rivulare, Racomitrium fasciculare*), 46 mosses – on rocks (typical *Andreaea rupestris, Arctoa fulvella*). The flora of Kochelevsky Volcano includes some interesting species. So, *Pohlia cardotii* and *Hygrohypnum bestii* are American species and are reported for the first time for Eurasia. The presence of these species confirms floristical connection between Kamchatka and America. *Philonotis yezoana* and *Racomitrium mutica* (Asiatic-American species) are collected for the first time for Russia. The find South-Asiatican species (*Trachycyctis ussuriense, Pogonatum japonicum*) is very interesting and indicates on the floristical connection between Kamchatka and South Asia. Rare species *Andreaea nivalis, Dicranoweisia intermedia, Isopterygium elegans, Thamnobryum alopecurum* were also reported.

Bryophyte communities in lava fields and around hot springs in Iceland

Klaus Dierßen, Barbara Dierßen

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К. Дирсен, Б. Дирсен. Моховые сообщества на лавовых полях и вокруг горячих источников в Исландии

Lava fields of a different age and development are a common feature in many parts of the Icelandic landscape. In the cool oceanic climate, weft forming bryophytes, especially *Racomitrium lanuginosum*, start the initial colonization of young lava streams and predominate most of the surface area in the later successional stages as well. In the vast cushions, the establishment of phanerogame seedlings is retarded. The space and direction of the primary succession depends on the vegetation composition of the surrounding area, the structural surface diversity of the lava fields and the amount of aeolian depositions stimulating the soil development. The age of the lava fields primarily determines the floristic diversity of the sites. The luxuriant bryophyte vegetation around alkaline hot springs normally exhibits a clear zonation according to the thermic gradient of the uppermost soil horizon. The bryophyte colonization starts at soil temperatures of about + 40°C. Continuous warm steam favours the development of luxuriant *Sphagnum cushions* around the spring basins and the brooks formed by the outlets of the springs. The vegetation composition is characterized by less cold adapted 'southern', species, which in Iceland are restricted to the hot spring areas. Some other species with a highly disjunct general distribution pattern (*Bryoxiphium norvegicum*, *Polytrichum sphaerothecium*) are restricted to areas of former volcanic activity. The zonal and successional pattern and the gradients of floristic diversity of the sites investigated were characterized.

Volcanic catastrophes of 20th century and vegetation of Kamchatka and Kurils

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Вулканические катастрофы XX века и растительность Камчатки и Курил

Thirty active volcanoes and a few hundred of dormant ones are situated at Kamchatka. The volcanism, both modern and holocene, controls the state of landscapes including plant cover at vast area - about 1/3 part of Kamchatka peninsula. Four giant eruptions producing more than 1 km^3 of volcanits, took place in 20th century: Ksudach in 1907, Bezymianny in 1956, Shiveluch in 1964, Tolbachik in 1975-1976. The influence of those and many other smaller eruptions on vegetation was never investigated. The impact of 40 active volcanoes of Kurils on vegetation is more intensive, since they are situated at very small territory (about 10000 km^2). During 20th century a few strong eruptions took place mainly in the northern part of archipelago, including giant eruption of Kharimkotan volcano in 1933.

During the last years, our team studied the influence of the eruptions of Kamchatka and northern Kurils volcanoes (in addition to above mentioned, these are Avachinskiy, Karymskiy, Kluchevskoy, Chikurachki and others) on vegetation. We focused on the following points:

1. Parameters of devastation of plant cover, in relation with type, power and explosiveness of eruption as well as the type, thickness and temperature of erupted volcanites.

2. Stability of dominants of plant cover in relation with a few factors (type of volcanites, season, thickness of snow, etc.).

3. Changes in diversity of flora of vascular plants, mosses and lichens.

4. Changes in structure of vegetation, including lowering of timberline and vegetation belts.

5. Plant successions and factors determining their direction and duration, basic stages and dominant plants of the stages.

Studying the mentioned parameters, we investigated plant cover of the areas in a whole, since no one of them had sketch of vegetation and list of flora.

As first approximation to description of the volcanic vegetation at the areas, we have got some data accordingly enumerated questions. The data will be presented in a paper.

Influence of 1853 and 1986 Eruptions of Chikurachki Volcano, Northern Kurils, on Vegetation

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The 2000 expedition studied the effects of the 1853 and 1986 eruptions of Chikurachki volcano (Paramushir Island, Kurils Islands, Russian Far East) on vegetation. For the first time, the geologic characteristics of both eruptions were determined using 52 measures of tephra thickness and granular structure. Isopachits of both eruptoins were mapped. Both eruptions severely impacted *Alnus fruticosa* thickets, which is the zonal vegetation. Two series of both primary and secondary successions were initiated, one being 148 years, the other 15 years. By investigaing the status of existing vegetation, we distinguished five sectors on the eastern slope of Chikurachki volcano. Each is characterized by different degrees of vegetation damage and successional trajectories.

The primary succession started by the 1853 eruption has reached a mature pioneer stage along the margins. Here mid-successional species such as *Empetrum nigrum* and *Pennellianthus frutescens* are dominant. However, on unstable tephra near the deposition axis, repeated disturbance has arrested vegetation in an immature stage. The secondary successions started after the 1853 eruption and undisturbed by the 1986 ashfall have led to full recovery. Primary successoins started in 1986 are in an very early colonizatoin stage on stable substrates. The common pioneer mosses *Plytrichum piliferum* and *Racomitrium lanuginosum* dominate, as they do throughout this region. The most successful secondary succession is occurring in the only slightly damaged *Alnus fruticosa* communities, where moss and lichen communities that were destroyed by tephra deposits are beginning to recover.

Biodiversity of the Alpine Vascular Flora of the North American Cordillera: the Evidence from Phytogeography

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С. Харрис. Биоразнообразие альпийской сосудистой флоры североамериканских Кордильер: факты из фитогеографии

Study of the vascular alpine species from different phytogeographical areas at 21 sites along the North American Cordillera from Alaska to Colorado indicates that there had been a good mixing of the floras prior to the Late Wisconsin glaciation. This probably occurred during the previous twelve cold events when much of the area was not covered by ice. Beringian and Circum-Arctic species were already well represented as far south as Colorado, and some Beringian species appear to have arrived before 3.5 Ma. During the Late Wisconsin glaciation, the central and northern parts of the Cordillera were covered by the glaciers. When deglaciation occurred at 14Ka, the emerging land was colonized by alpine species from the unglaciated U.S. Cordillera, from Alaska, or from isolated nunataks. About 10.2Ka, the climate warmed abruptly and the alpine floras became isolated on individual mountain tops. Further migrations were impossible resulting in a very varied distribution of species, determined by the distance from the unglaciated refugia, relative ease of migration of the phyto-geographic groups and the soil moisture regimes in the alpine soils. Once again, the Beringian and Circum-Arctic species proved more mobile than the regional endemics.

Substrate Control of Plant Colonization on Recent Mauna Loa Basaltic Lavas at High Elevation (3000 m), Congruent with the 10°C Mean July Isotherm

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Дж. Джувик, М. Мерлин. Влияние субстрата на заселение растениями свежих базальтовых лав высокогорной части (3000 м) вулкана Маноа Лоа, совпадение с изотермой 10°С для средних температур июля

The active Hawaiian volcano Mauna Loa (summit elevation 4,170m) lies at 20° N in the tropical north-central Pacific Ocean. The mean summer (July) air temperature at the upper limit of woody vegetation on Mauna Loa (3,000m) is approximately 10°C, similar to summer temperatures in the volcanic areas of central Kamchatka, near sea level. Native plant species colonizing recent Mauna Loa basaltic lavas at high elevation include several species with close affinities in the Kamchatka flora (e.g., *Vaccinium* sp., *Asplenium* sp., and *Polypodium* sp.). Comparison of the successional trajectories of lava flow pioneer plant communities on sub-alpine Mauna Loa (altitude induced, non-seasonal thermal stress) and in sub-arctic Kamchatka (latitude induced, seasonal thermal stress) provides a unique research opportunity in bio-climatology. On the upper slopes of Mauna Loa plant colonization is strongly influenced by variations in the structure and micro-topography of lava flow substrates, which range from slab or plate-like and ropey surface textures (*p hoehoe*) with small cracks and fractures to lava cinder and boulder fields (*a'*). This study has documented that plant colonization by dominant woody species (including *Vaccinium reticulatum*, *Styphelia tameiameiae* and *Dubautia ciliolata*), as well as grasses, ferns and bryophytes (*Trisetum globeratum, Agrostis sandwicensis, Pellaea terifolia, Asplenium adiantum-nigrum* and *Rhacomitrium* sp.) is most favored on *p hoehoe* substrates. On *a'* and *pahoehoe* lava flows of similar or identical age, plant diversity and biomass are an order of magnitude higher on the *p hoehoe* substrates. In addition, for all plant taxa considered, the upper altitudinal limit of species occurrence was typically 400-500m higher on *p hoehoe*. Factors influencing the comparative advantage of *p hoehoe* for initial plant colonization include the following: 1) cracks and fissures in *p hoehoe* favor accumulation of rainfall runoff (in these arid uplands where annual precipitation averages 400mm/yr) and trap inorganic and organic particles from the surrounding impervious lava surfaces, creating both a more favorable rooting medium and enhanced moisture conditions for plant growth; 2) the crevices and voids in *a'* lava boulder fields are ubiquitous, resulting in a lack of comparable micro-topographic accumulation sites favorable for plant growth; 3) preliminary microclimate sampling (surface and subsurface temperature monitoring) indicates that *p hoehoe* cracks have thermal properties more conducive for plant growth than that found in comparable *a'* interstices. The results of this study document quantitatively an unambiguous example of substrate control in primary ecological succession in the alpine zone.

A Comparison of Pioneer Vegetation on Kamchatka Volcanoes and Volcano St. Helens

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П.В. Крестов, С.Ю. Гришин, В.П.Верхолат, Р. дел Морал. Сравнение пионерной растительности на Камчатских вулканах и вулкане Сент-Хеленс

The pioneer vegetation on Kamchatka volcanoes is formed basically from the representatives of indigenous flora. The diversity of plant communities and aggregations depends on the substrate variability as well as biogeoclimatic zone. Main questions addressed in this study were (i) how many plants form the pioneer plant communities and aggregations; (ii) what is a part of indigenous flora in their formation; (iii) how does climate affect the species composition of pioneer vegetation and (iv) how does substrate regulate the species combinations and are there any differences between the pioneer vegetation of phytogeographically different regions. Data were collected at the volcanoes Ksudach, Avachinskiy, Karymskiy, Kluchevskoy, Bezymianniy, Shiveluch (all in Kamchatka), Chikurachki and Ebeco (Paramushir Isl.) by squares 1 by 1 m on different types of substrate. Data from St. Helens volcano were extracted from the literary sources. TWINSPAN was applied for grouping of floristically similar plant communities and delineation of ecologically similar species groups. The results were shown with an aid of Vtab Ecosystem reporter.

Phytogeographically post-volcanic pioneer vegetation on Kamchatka comprises 2 different parts: southern and northern (central) Kamchatka. Differential species for these regions are *Pennelianthus frutescens*, *Ermania parryoides*, *Papaver alboroseum*. The Sent-Helens vegetatio, despite the similarity with Kamchatka vegetation remains low, shows somewhat closer species composition with southern Kamchatka volcanic vegetation.

The striking difference in pioneer vegetation was found on the different kinds of substrate. Characteristic species for the pumice tephra deposits are *Stereocaulon grande*, *S. vesuvianum*; for the basalt tephra deposits – *Papaver microspermum*, *Leymus interior*, *Stellaria eschscholtzii*, *Racomitrium lanuginosum*; for lava flows – *Saxifraga cherlerioides*, *Saxifraga funstonii*, *Cassiope lycopodioides*; on pumice pyroclastic flows – *Pyrola minor*, *Trientalis europaea*, *Maianthemum dilatatum*. Species composition on pumice deposits of St. Helens appeared to exceed that of Kamchatka volcanoes because of great number of low specialized species from the indigenous flora.

The Role of Microflora and Algoflora in Study of Volcanic "Deserts" After Volcanic Eruptions

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Т.И. Кузякина. Роль микрофлоры и альгофлоры в изучении вулканических пустынь

Analyses results of ashes of Tyatya, Tolbachic (Large crack Tolbachic eruption) and Alaid volcanoes taken during eruptions showed practical absence of microorganisms in them. Fresh volcanic ashes are not toxic for microorganisms (ashes had no microbial stasis).

Air microorganisms contaminate barren ashes within several hours. Microbiocenoses formation (pedescopes and glasses of overgrowing) is not the same on the different ash areas (Tyatya volcano). In ashes near Otvazhny crater and in the forest defeated by gas-ash cloud microorganisms growth is weak, there are not enough shaped colonies, biology activity decay is low. During the increasing of nutritious substances entering and energy from the forest litter in the Sakhalin fir forest and tall forb meadows falling biological activity increased, the giant colonies of bacterial rods prevailed in microbiocenoses.

Ashes developing by microorganisms may be occurred not only from above, it may be occurred from the boundary with the buried soil. The more time passes after the eruption the closer microbiocenoses to soil type cenoses.

Algaes populate volcanic ashes and become one of the sources of organic substance at initial primitive soils. Ecogenesis on volcanic ashes is similar to the suitable processes at industrial damps. The stage described here corresponds to the airophiton stage.

It is necessary to show some features of algaes distribution in ashes of Tyatya volcano. So, almost every time in developing of upper ashes layer Bracteacoccus minor and Pseudococcomyxa simplex take part. At the same time autochthonous algoflora in the buried soil at the depth of 60 and even 110-120 sm is the preservation for a long time. Bluegreen algaes were occurred only at the bottom and on the edge of Otvazhny crater, id est at the areas trying to the effect of hot steams.

Sulfataric fields rocks and soils of Mendeleev and Golovnin volcanoes are poor of algaes. Only green and yellowgreen algaes were occurred there.

The number of algaes species at volcanoes: Tyatya – 64, Golovnin – 13, Mendeleev – 2, Tolbachic (LCTE) – 20.

Use of Capabilities of Remote Sensing at Researches of a Condition of Vegetation on Volcanoes of Kamchatka

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В.А. Мелкий, Р.Н. Сабиров. Использование возможностей дистанционного зондирования для исследования состояния растительности на вулканах Камчатки

Modern volcanic processes renders on vegetation rather various effect, which first of all depends from character of their activity. The direct influence of volcanic activity on vegetation is shown in the following kinds: destruction by lava and pyroclastic flows, explosive air waves, debris of explosions, dusting of surface parts of plants, aggressive gases and them connections.

The plots of the lost wood confidently are decoded on the space images on almost of white or grey tone of ground vegetation. On a distance of 8-10 kms from an eruptive center of volcano in operative ranges high-power ashfall on images of various scales the separate kept trees or their groups. In some years after eruption in process of distribution young verdure have become over on plot with the well kept soil cover the increase of number and size stains of more dark tone is well traced. The segments covered dried cedar and alder elfin woods are characterized by much more white tone in comparison with similar alive vegetation and practically by full absence of granularity of a structure of figure.

The volcanic ashes in any place of their loss cover leaf blades of plants. The areas of distribution of ashes are rather extensive. After eruptions of volcanoes Sent-Helens and Shiveluch the particles of ashes were found out on leaf blades of trees 1,5 months after eruption. The vegetation of these territories experiences various stressful loading. The changes of a condition of chlorophyll are registered practically in any range of a spectrum of electromagnetic waves.

Without any doubt, the leading role in determination of changes of a vegetative cover under influence of developments of volcanism is played decoding of the space images received with the help photographic and scanneric of systems established on satellites "Resource -F", "Resource -O", Irs, Landsat, Spot and others in ranges 0.478-0.508, 0.492-0.536, 0.514-0.558, 0.566-0.638, 0.604-0.7, 0.725-0.920 μ, and also near IR (0.74-1.3 μ), IR (1.5-1.8, 2.2-2.6, 3.0-3.6, 4.2-5.0 and 7.0-8.0 μ) and thermal IR (8-12 μ) ranges of an electromagnetic spectrum.

Changes of a condition of sheet plates of vegetation under effect of volcanic ashes, SO_2 is precisely fixed on change of a level of fluorescence. The essential achievement in the field of study of reaction of vegetative covers on effects of external environment will be received at the analysis of levels ILF (induced laser fluorescence), registered after effects laser scanners, established on air or space launchers.

The Plant Cover of a Hydrothermal Field Area in Southern Kamchatka

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В.Ю.Нешатаева. Растительный покров района гидротермальных полей южной Камчатки

A detailed study and mapping of plant cover of Nizhne-Koshelevsky hot spring area (50,000 ha) in Southern Kamchatka was carried out in 1990-1991. The plant communities of the hot-springs valley were studied in 600 permanent quadrates (0.04 m^2 each). The vegetation of the whole hydrothermal field was studied at 5 transects (12 km total length) laid in subalpine and alpine belts on the Koshelev volcano slopes. The density of layers, the floristic composition and the coverage for every species were defined at 150 sample plots (100 m^2 each). Vegetation maps at scales 1:1000 (for the hot springs valley), 1:10000 (for the hydrothermal field area) based on land data evaluation and the interpretation of aerial photographs were compiled. The plant cover of the area was formed by Siberian dwarf-pine (*Pinus pumila*) elfin woods, alder (*Duschekia kamtschatica)* thickets, subalpine meadows (with the predominance of *Parageum calthifolium, Geranium erianthum, Rhododendron camtschaticum*), alpine tundras (with the predominance of *Vaccinium uliginosum, Empetrum sibiricum, Diapensia obovata)* and thermophilic plant communities (*Carex appendiculata, Calamagrostis purpurea, Agrostis pauzhetica* and bryophytes predominated). 142 species of vascular plants, 78 species of bryophytes and 95 species of lichens were found in the studied area. The most damaging influences on the plant communities surrounding the hot springs were trampling and penetration of rural species connected with visitors (tourists and residents).

A Comparison of Heath Community of Two Volcanoes, Mt. Ebeko, Paramushir Island and Mt. Taisetsu, Hokkaido, With Reference to the Effects of the Volcanism on the Plant Distribution

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С. Окицу. Сравнение верещатников двух вулканов, Эбеко (Парамушир) и Дайсецу (Хоккайдо) в аспекте влияние вулканизма на распространение растений

On the east slope of Mt. Ebeko, Paramushir Island, northern Kuriles, the heath community dominated by the treeless dwarf shrubs widely develops. It is resemble to the wind exposed dwarf scrubs of Mt. Taisetsu, Hokkaido, northern Japan in dominant species and physiognomy. However, Mt. Ebeko has repeatedly erupted, being quite active volcano at present. Such volcanism should affect the plant distribution on Mt. Ebeko as compared with that of Mt. Taisetsu, although Mt. Taisetsu is also a less active volcano. This presentation discusses the effects of the volcanism on the plant distribution. On Mt. Ebeko, the number of the species in a community decreases rather sharply toward the higher altitudes. This can be partly explained by the effects of repeated volcanism of Mt. Ebeko. The community in the higher altitudes can be supposed to still remain earlier stages of the succession; repeated volcanism prevents the progress of succession especially in the higher altitudes. The relatively lower total number of species (totally 58 species) and the existence of the scares vegetation cover on the upper part of the slope, as compared with those of Mt. Taisetsu, support the effects of the volcanism on the vertical distribution of plants. Another issue relating to the effects of volcanic activity on plant community is an admixture of species in different habitats. The heath community of Mt. Ebeko contains species in different habitats. This fact shows no clear habitat segregation among the species in the heath community still now. It may be assumed that repeated volcanism prevents the community from establishment of fully matured habitat segregation among the species by insufficient time to development of the community.

Volcanic Influence on the Holocene Peat Bog Vegetation

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Н.Е. Зарецкая, О.Н.Успенская. Влияние вулканизма на растительность голоценовых торфяников

We performed the extensive radiocarbon dating of the South Kamchatka peat bogs with enclosed layers of volcanic tephra. We sampled peat from under and above tephra layers to date them. Thus we obtained the information (data) about the sources and ages of volcanic eruptions (including marker ashes) imprinted in studied peat bogs. The plant macrofossil analysis of dated peat samples, which we carried out to evaluate radiocarbon age deviations, enabled us to analyze the Holocene peat bog development under the tephra falls influence.

Our main conclusions are:

The onset of the studied peat bog formation in the South Kamchatka was controlled by volcanic activity. The peat accumulation started not earlier then c. 7200 BP, and the majority of the peat bogs dates back from c. 5500-5000 BP or less.

The influence of volcanic eruption on peat bog vegetation depends on thickness, grain size and chemical composition of tephra layer overlapping the bog surface; the magnitude of the eruption does not play any important role.

A deposition of tephra layer thicker than 10 cm destroys the existing bog assemblages and the "pioneer" plant communities develop on the tephra surface.

The tephra layer 2-10 cm thick causes the change of proportion of plant certain species inside the existing assemblage: the amount of halophytic and xerophilic species (*Carex cryptocarpa*) increases versus the hydrophilic ones (*Sphagnum fimbriatum, Equisetum fluviatile*). The tephra layer less than 2 cm thick does not influence on the peat bog vegetation, or influences moderately.

Vegetation recovers on the tephra surface, even if it is very thick, rather fast due to very high bioproductivity and precipitation rates: radiocarbon dates under and above the tephra layer do not fix the gap in the peat accumulation.

Besides, we obtained data on influence of a single volcanic event on the vegetation of different peat bogs, tracing the tephra layers through several peat sections. Using the radiocarbon and plant macrofossil data, we obtained the ages of c. 30 South Kamchatka volcanic eruptions.

A Second Decade of Understory Recovery from Burial by Tephra

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Д.Б. Зобель, Я.А. Антос. Второе десятилетие восстановления нижних ярусов сообществ после погребения тефрой

Cover of understory species in old-growth subalpine conifer forest was assessed in the 21st year after burial by tephra from Mount St. Helens, USA. Plots were last measured 10 years before. One hundred permanent plots on natural tephra and 50 plots cleared of tephra the season of the eruption were used at four sites: two had 15 cm tephra, the others 4.5 cm. One site with each tephra depth was snow-covered at the time of the eruption, which caused burial of small woody plants by tephra.

Natural tephra plots had significantly less plant cover than did cleared plots for bryophytes at all sites, for herbs at the two deep-tephra sites, and for shrubs and small, pre-eruption trees at all sites except the snow-free one with shallow tephra. More seedlings established on tephra than in cleared plots, except where shallow tephra fell on snow.

Some growth forms have "recovered" to their original importance: cover of shrubs at all sites except deep tephra with snow, and of herbs with shallow tephra, was higher in 2000 on tephra than in 1981 in cleared plots, which we use to represent pre-eruption vegetation. However, these growth forms have less cover in natural than in cleared plots in 2000 because cleared plot cover has increased significantly since the eruption. For bryophytes at all sites, herbs with deep tephra but no snow, and shrubs with deep tephra on snow, cover remains less than cleared plot values in any year, indicating incomplete recovery.

For all growth forms and sites, the significance pattern between natural and cleared plots did not change from 1990 to 2000. Thus further recovery appears to be slow. Differences in species composition may persist as cover of a growth form "recovers" (approaches cleared plot values for 1981), as exemplified by herbs in deep tephra with snow.

Abstracts of poster presentation

Peat Formation and Volcanic Ashes of Kamchatka

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А. Алискеров. Формирование торфяников и вулканические пеплы Камчатки

The effect of volcanism on vegetation is clearly seen in the case of the formation and accumulation of floristic residues in peat bogs. According to the existing classification, peat bogs are divided into upper, lower and interstitial, depending on the type of bog in which they occur. However, one of the chief characteristics of the conditions of growing, vegetative accumulation and transforming of vegetative material into different types of peat, is the mineralization of bog water, either atmospheric or ground. Upper peat bogs differ from the lower ones, respectively, in their amount of mineral impurity. In upper bogs, the ash content makes up 2-6 % of the peat rising to 6-20 % in lower bogs.

Such a classification of peat moors and accumulative peat bogs is not useful for Kamchatka; however, because of well-expressed volcanism, Kamchatkan waters differ a little from the surface waters in terms of mineralization. The rocks, in which ground water infiltration occurs, are mostly fixed magmatic units of basaltic and andesitic content. On the other hand, the rocks of chemogenic and biologic origin, such as limestone and other well-soluble residues, are absent. Therefore, aqueous waters including ground and surface waters are mostly of equal mineral content.

Ashfalls are typical for the peninsula and cover a considerable part of it with a thick layer of tephra. Because of volcanic activity in Kamchatka, peat bogs have high-mineralization and ash content of peat varies from 8 to 30 % and even, in local cases, 40 %.

Taking into consideration all mentioned above, it would be more logical to classify the peat bogs of Kamchatka peninsula on the basis of the distance from the centers of active volcanism. Peat would be classified on the content of volcanic ash and the mineralization index. From this point of view, the following provinces could be established with different peat zonality: the Eastern-volcanic zone (up to 40 %), the Sredinno-Kamchatskaya zone (up to 30 %) and the Western-Kamchatkan lowland, a zone remote from volcanic centers, (up to 20 %).

Vegetation of Central Region of the Mexican Volcanoes

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Л. Альмейда-Ленеро, А.М. Клиф. Растительность центральной части Мексиканского вулканического района

This work includes the phytosociological studies aimed to locate and describe vegetation associations on the central region of the Mexican Neovolcanic Belt. The samples were taken using the Zurich-Montpellier approach.

The "zacatonal alpino" (tropic alpine grassland) of the Popocatépetl (5452 m) and Nevado de Toluca (4690 m) volcanoes, and the coniferous forest are defined as the principal types of vegetation. The zacatonal alpino is characteristic of the open supra-forest vegetation between the timberline *Pinus hartwegii* forest and the periglaciar area from 3860 to ca. 4300 m, the lower zone or zacatonal proper and from 4300 to 4550 m the upper zone or superzacatonal. Twenty one families, 37 genera and 58 species of vascular plants are recorded for the studied area. The most representative life form is hemicriptophyte and the bunch grass (or tussock) is most common growth form.

The upper mountain coniferous forest belt, located within an altitudinal range of 2840-3830 m along the slopes of the Popocatépetl Volcano is shown. A total of 106 vascular species were recorded, belonging to 71 genera and 33 families. In these forests the physiognomic complexity and the number of plant taxa increases with decreasing elevation. At higher elevations the forest of **Festuca tolucensis-Pinus hartwegii**, prevail in the tree layer whereas bunchy grasses dominate the understorey. At middle slopes Fir forest (*Abies religiosa*) associations, display larger complexity dominated by Phanerophytes. The forest association of **Abies religiosa-Cupressus lusitanica** is restricted to the lower foot slopes throughout Mexico's Basin. A large number of plant species indicated grazing and burning activities. The temperate component and elements largely include families and genera of the three coniferous forest communities from Popocatepetl volcano.

Latitudinal phytogeographic comparison of the upper mountain forest genera on Popocatepetl and Iztaccihuatl volcanoes with the corresponding Guatemalan and Costa Rican forests, shows that the tropical component decrease gradually from south to north. Phytogeographically a strong similarity was observed between the coniferous forests of Mexico and Guatemala. It is presumed that present-day altitudinal zonation and phytodiversity of the studied communities depends on geographical position, altitude, temperature and precipitation, Such factors have controlled the migration and the establishment of cool temperate species in cool areas at higher elevation in the tropics and vice versa.

Plants and volcanoes in the geological past

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Е.В. Бугдаева. Растения и вулканы в геологическом прошлом

The Late Mesozoic flora and floristic paleosuccessions were studied in Transbaikalia (Russia). The fossil plant-bearing deposits occur in widely-distributed volcanogenic deposits of Shadoron and Unda-Daya Formations. The communities of fossil plants are divided into two groups:

1) Shadoron assemblage is dominated by czekanowskialeans: *Phoenicopsis* (Ph) and *Czekanowskia* (Cz). *Pityophyllum* is rare there. Herbaceous vegetation is dominated by ferns *Coniopteris* (Con), *Cladophlebis* (Cl) and cycadophyte *Heilungia* (Hl).

2) Unda-Daya assemblage is dominated by conifers: Pityocladus, Pityospermum. Herbaceous vegetation is dominated by Equisetum.

The Shadoron assemblage is divided into two groups: a) with dominants Ph(Cl) forming the basis of vegetation association of phytooryctocoenoses of Lower Conglomerate Subformation; b) with dominants Cz (Con) prevailing in phytooryctocoenoses of Middle Eruptive Subformation and Upper Tuffaceous one.

The following interpretation of paleosuccessions was suggested. Ph(Cl) from Conglomerate Subformation is climax vegetation of flood plains. After that, the subsequent volcanic activities disrupted this vegetation. Cz(Con) is mainly pioneer association, the successional development was suppressed by intensive volcanism activities and this phytocoenosis was unable to reach the climax stage. The successional change Cz→Ph occurred during the time of sedimentation of Upper Tuffaceous Subformation. This situation reflects the formation of climax vegetation under more stable conditions (weakening of volcanic activity). The abrupt alteration of vegetation composition has been surveyed at the boundary between Shadoron and Unda-Daya Formations. The changes of basic dominants combined with facies changes (lacustrine deposits replaced alluvial and tuffaceous ones).

The Dynamics of the Vegetation Development in the Tolbachik Area

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В.Е.Быкасов. Динамика формирования растительности на Толбачинском Долу

The Great Fracture Tolbachik Eruption is one of the most significant phenomena of the 20th century. During that natural ecologic disaster the soil and vegetation cover was completely annihilated within an area of nearly 500 km^2, and some substantial modification of the structure of biocoenoses occurred within an area of nearly 300 km^2. At the same time, the process of mechanic, thermal and chemical damage of vegetation of the Tolbachik Area resulting from the eruption of the North and South breaches is differentiated according to both its intensity and the range of its influence and the certain mode of influence.

No less striking is also the differentiation marked in the character, dynamics and direction of the processes of vegetation cover regeneration of the damaged sections of the valley. For instance, the vegetation of mountainous tundra having occupied practically all the north half of the central and most elevated (800-900 to 1500-1800 m) part of the valley before the eruption was completely interred up to the bed of the Vodopadny (Waterfall) Stream at its west side and to the bed of the right head of the Tolud River at its east side during the eruption. However due to strong winds which removed nearly 0.2 km^2 of precipitated pyroclastics in the very first winter the thickness of the slag-and-ash layer upon the sections covered with the vegetation of mountainous tundra decreased practically twice. That is why hardly interred but having not died grass-and-bush vegetation of mountainous tundra has currently regenerated over all the territory where the original thickness of slag-and-ash deposits reached 15-20 cm. And only because of that phenomenon could mountainous tundra move to the center of the eruption as far as 3-5 km.

The Eolic Transfer of Tephra as a Factor of Ecosystem Transformation (the Example of the Tolbachik Area)

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В.Е.Быкасов. Перенос тефры как фактор изменения экосистем (на примере Толбачинского Дола)

The eolic differentiation of loose volcanits in the process of thrust, transportation and primary deposits of pyroclastics occurs during the eruption. Particularly the form and scale of eruptive clouds, special extent and direction of slag-and-ash train, differentiation of precipitating pyroclastics in size and weight (density) and some other features are to a considerable degree caused by the character (steady, episodic, impulsive, etc.), dominating direction and the wind power (speed).

In no less degree the activity of wind also manifested in the subsequent processes of the transfer and re-sedimenting of tephra, what is particularly evidently traced both in the modification of the underlying surface with the formation of diverse wind forms of nanorelief (wind board, snowdrifts, etc.) and in the processes of repeated damage (interment and abrasion) and pioneer regeneration of vegetation coverage of slag-and-ash ecosystems due to the creation of pollen substance.

Flora of the Geothermal Regions of Kamchatka and Its Ecological and Physiological Features

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О.А. Чернягина, О.Л. Бурундукова. Флора геотермальных районов Камчатки, ее экологические и физиологические свойства

The sites of geothermal activity are known in many volcanic regions of the world. Kamchatka Peninsula has considerable geothermal activity, 112 groups of hot springs with different temperature and mineral composition located in different natural and floristic regions are described from the south of the peninsula up to its northern extremity.

Flora and vegetation of hot springs, geysers and fumarols, of thermal localities has been the subject of concern of the explorers of Kamchatka since the middle of the 18th century. We have generalized all data, available for today, on the flora of vascular plants of the geothermal sites of Kamchatka. The list of flora includes 292 species, representing 171 genera and 62 families (on the total there are 1140 species known for the flora of the peninsula), 19 species are met in Kamchatka only near hot springs. There are endemic species of Kamchatka, among them: *Agrostis pauzhetica* Probat., *Bidens kamtschatica* Vass., *Fimbristylis ochotensis* (Meinsh). Kom.

The geothermal regions of Kamchatka have a long history of development. Hot springs are traditionally used for the therapeutic purposes, as the geothermal power sources and are visited by the tourists. As the result of this, vegetation around many of hot springs is considerably changed or destroyed, and the species composition of the remaining plant communities has been invaded with adventive species. In total there are 29 such species in the studied flora. However there are still numerous places, where flora and vegetation changed to a low extent or remained intact, practically virgin.

Such well-preserved sites are natural polygons for the studies on the mechanisms of adaptation of plants to extreme conditions. Efforts already taken by us have given interesting outcomes: it is revealed that the hot springs of Kamchatka are refuges for thermophilic species with 4 type of the photosynthesis. It is known that *Fimbristylis ochotensis* growing at Palana hot springs (59°N) inhabits one of most northern sites on the Earth where the 4 plants from the family Cyperaceae are met. It is also known that *Fimbristylis ochotensis*, being an obligate thermophilic species, forms communities on the sites with the temperature of soil not less than 40°C. According to the data of E.I. Den'ko (Komarov Botanical Institute, Russian Academy of Sciences), who kindly studied material, collected by us, this species has the highest, among 700 other studied species, thermal resistance of cytoplasm of the epidermal cells of the leaves.

Flora and Vegetation Near Hot Springs in the Valley of Kirevna River

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О.А. Чернягина, В.Е. Кириченко. Флора и растительность вокруг горячих источников в долине реки Киревны

The river Kirevna flows in the eastern piedmonts of Sredinniy Range of Kamchatka Peninsula. There are numerous outputs (more than 400) of thermomineral sources in the river valley and about 20 km around it, with temperatures from 20 to 100°C; the sources are gathered in 6 large groups. The groups of hot springs in the upper and bottom parts of valley are partially used as "wild" health resorts. The sources in mid-range of the valley, described for the first time in 1989-92, are hard-to-reach, and are not affected by anthropogenic effect, so they represent the most undisturbed geothermal ecosystems of Kamchatka.

Kirevna geothermal system is the largest geothermal region of Central Kamchatka. A broad spectrum of thermal localities is formed here - from dry warmed-up sites up to thermal moors that provide existence of the whole complex of species of vascular plants, mosses and lichens. Many of them grow in Kamchatka only near hot springs, including endemic species and those ones that grow at the limit of their area. Vegetation is represented by both typical communities of the geothermal regions of Kamchatka, and unique assemblages. This area is of special value for maintenance of the biological diversity in the region.

Verkhnekireunskie hot springs were mostly studied from botanic viewpoint. There are about 200 outputs of thermal waters, in the form of large boiling gryphons and numerous jet streams, with temperature 20-100°C and output rates from 0,01 up to 4 l/s on the area of 1200 × 100 m. About 250 species of vascular plants are found in the vicinity of these hot springs, including 86 species growing on warmed up sites. The flora of true mosses, according to the present-day data, includes 74 species, 33 species of them are met in the thermal localities. 25 species growing here are recorded for Kamchatka for the first time (Viunova, 1991). There are 41 species of liverworts (determined by A. Potemkin from our collections), the finding of *Marchantia aquatica* (Nees) Burgoff. is the most interesting. This species forms monodominant communities in the upper parts of boiling springs in the zone influenced by hot steam. A new occurrence of this species is far from its main geographic range. There are 13 species of lichens on thermal platforms, including *Cladonia vulcani* Savicz., met in analogous conditions in Japan and in Northern America.

Thermomineral sources of the valley of Kirevna river are offered by us for inclusion in the list of Ramsar lands, as geothermal wetlands (Wetlands of Russia, 2000).

Impact of *Coriaria arborea*, a Nitrogen-Fixing Shrub, on Seed Banks During Primary Succession on Mt Tarawera, New Zealand

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Б. Кларксон, Лоренц Уолкер, Б. Кларксон, В. Сильвестер. Воздействие азотофиксатора *Coriaria arborea* на банки семян в ходе первичной сукцессии на вулкане Таравера (Новая Зеландия)

An experiment to determine the effect of *Coriaria arborea*, a nitrogen-fixing shrub, on soil seed banks from habitats representing a post-volcanic successional sequence on Mt Tarawera, New Zealand, was conducted over two years. The habitats were "Open": no vegetation, "Herb": scattered herbaceous mats, "Shrub": dominated by *Dracophyllum subulatum*, "Young Coriaria": scattered newly invaded Coriaria, and "Old Coriaria": established stands of Coriaria. The ages of the vegetation in these habitats were approximately 0, 50, 80, 95, and 110 years respectively. "Young Coriaria" and "Old Coriaria" soils had significantly more seedlings and species emerge than the other three treatments, and were the only soils with Coriaria seedlings. "Old Coriaria" soils had significantly more seedlings than "Young Coriaria" soils but similar numbers of species. The most common species germinated over distinct time periods with germination peaks in the order: *Holcus lanatus*, a non-native grass (3 weeks), Coriaria (8 weeks), a native fern *Paesia scaberula*, (14 weeks), a non-native herb *Sagina procumbens* (26 weeks), and a native herb *Pseudognaphalium luteo-album* (42 weeks). Later successional tree species present in the vicinity were conspicuously absent. Seeds were still germinating at the end of the experiment but rates declined markedly during the second year. The results show that establishment of Coriaria greatly accelerated a trend of increasing abundance and diversity of seeds in the soil with vegetation age.

Influence of Processes of Depression Formation in Ashes on the Kamchatka Vegetation

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В.Д. Дмитриев, Н.В. Ловелиус. Влияние процессов провалообразования в отложениях пеплов на растительность Камчатки

For an estimation of influence of depressions of ash cover on preservation of stands of trees and meadow vegetation the analysis of climatic characteristics (precipitates, their allocation in a vegetative cover, levels of the Kamchatka river) and frequency of formation of depressions at the bottom of Klyuchevskii volcano for a few decades is carried out. The cyclicity of depression formation which is close to 11 and 22-year cycles of solar activity and more small-sized rhythms on the increase and decrease phases of these cycles are discovered. The relationships between these characteristics and growth of model trees of chosenia and larch are considered. The mechanism of depression formation is reconstructed which results in collapses landslides of stands of trees and their loss, especially when the bottom of depression is flooded, and in formation of buried soils.

As a whole, the current depression formation reduces the areas of meadows, strengthening the scope of exposure of the ash surface and intensity of a scour of sward by atmospheric precipitation. The analysis of tree growth, solar activity, hydroclimatic and geological factors reveals the possibility an opportunity of prediction of recurrence of depression formation in the next solar cycles and tendencies of reduction of vegetative assemblages in ash landscapes of Kamchatka.

Plants Colonizing the Volcanic Island, Surtsey

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С. Фридрихсон. Заселение растениями вулканического острова Серцей

Surtsey is a new volcanic island off the southern shore of Iceland. It was formed by a volcanic eruption, which started in 1963. The island was originally 2.8 km^2 in size, but during its 38 years lifetime it has eroded down to 1.8 km^2. The vascular plant life on Surtsey has been monitored from the beginning. The first plant was discovered in 1965. Since then the dispersal, colonization and formation of communities have been studied. In the summer of 2000 there had been 55 vascular plant species recorded growing on Surtsey, about 85 % of which are permanent residents. Of these species 75 % may have been carried to Surtsey by birds, 11 % by sea and 14 % by air. About 80 % may have derived from other islands in the neighborhood. The colonization of the dry sandy lava is slow. In contrast, vegetation in a sea gull colony is rapidly developing, covering 6.3 hectares, about 4 % of the dryland of Surtsey. The sea gulls are bringing plant seeds and increasing the soil fertility of that area by their droppings and food wastes.

Vegetation Dynamics on the Volcanic Izu islands, Japan

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Т. Камидзо. Динамика растительности на вулканическом острове Изу (Япония)

The Izu islands, situated in the warm-temperate zone of Japan are composed of 10 or more volcanic islands including active volcanoes, all of which are smaller than 100 km^2 in area. Some of them reach more than 800 m in height. The vegetation of the Izu Islands is patterned by substrate age and altitude. On the active volcanoes, the vegetation successionally changes from *Alnus sieboldiana* and *Reynoutria japonica* shrub, to *Persea thunbergii* and *Prunus speciosa* forest, to *Castanopsis sieboldii* forest. The rate of succession seems to be slower at higher altitudes. On Miyake-jima Island, an active volcanic Island, the above-ground biomass was 20 kg/m^2 (160 m a.s.l.) on the 125-year lava flow. The rate of above-ground biomass accumulation was considerably faster and soil N concentration was extremely high on the 37 and 125-yr lava flows where Alnus was dominant. The faster AGB development may be due to the facilitation effects of N-fixation by Alnus. On Mikura-jima Island (850.9 m a.s.l.), an old Pleistocene volcano, vegetation changes with altitude: a low-altitude Castanopsis forest, a middle-altitude transitional Castanopsis forest and a higher-altitude mixed *Buxus microphylla*, *Eurya japonica* and *Trochodendron aralioides* forest. Tree height decreases with increasing altitude, and leaf size of evergreen broad-leaved species decreases from notophyllous at lower altitudes, to microphyllous and nanophyllous at higher altitudes. The decline in tree height and the change in leaf size are characteristic of the alititudinal zonation on the old volcanoes of the Izu islands.

Since July 2000, the Miyake-jima has been erupting and ejecting a large amount of volcanic ash. Such a type of eruption is for the first time in 2000 to 3000 years. The wind-borne material covered extensive area, and creating a new substrate for primary succession.

Allozyme Diversity of Two Rare Oxytropis Species in the Kuril Islands

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А.Б. Холина, О.Г. Корень, Ю.Н. Журавлев. Аллозимное разнообразие двух редких видов Oxytropis с Курильских островов

The analysis of genetic diversity of island endemic plants provides an appropriate tool for understanding the evolution of biota on island areas. We investigated allozyme polymorphism in two closely related plants *Oxytropis retusa* Matsum., an endemic species of the Kurils, and *Oxytropis hidaka-montana* Miyabe et Tatew., restricted to the Hokkaido (Japan) and the southern Kurils. Isozyme patterns of these plants were examined by starch gel electrophoresis for 15 enzymatic systems. The results suggested that multilocus systems encode 7 of the studied enzymes, whereas 8 enzymes are under single gene control in both species. A total of the 21 loci were revealed. Allozyme variations were found for FE (E.C. 3.1.1.2.), GPT (E.C. 2.6.1.2.) and PGI (E.C. 5.3.1.9.). Both species demonstrated the same pictures of banding patterns at 20 homologous loci, the only difference of migration distances for isozyme bands in Pgi-2 was observed. Although the two species share a site of common alleles, interspecific differences in allele frequencies were detected (2 values for heterogeneity were significant). No deviations from Hardy-Weinberg equilibrium was found at all polymorphic loci. The fixation index (F) was 0.04 for *Oxytropis retusa* and -0.17 for *Oxytropis hidaka-montana*. Negative F values indicates an excess of heterozygotes. Proportion of polymorphic loci (P) and number of alleles per locus (A) were 0.14 and 1.19 in two species. The observed heterozygosity values were 0.068 and 0.076 for *Oxytropis retusa* and *Oxytropis hidaka-montana*, respectively. Both species showed low levels of allozyme diversity commonly characteristic of endangered species. It seems the similarity of these species is attributed to their common origin. The genetic identity value was 0.989, suggesting only slight divergence among species. However, the period of evolution needed for such divergence is more prolonged, than the period of formation of the Kurils.

Effect of cryoconservation on seed germination in some plants of the Kuril Islands and Kamchatka Peninsula

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А.Б. Холина, Н.М. Воронкова, В.В. Якубов. Воздействие криоконсервации на прорастание семян некоторых растений Курильских островов и Камчатки

Among the different ways of preserving the plant species inhabited the volcanic areas the long-term storage of seeds by cryoconservation in liquid nitrogen (LN) at – 196°C is reliable and relatively cheap method. Information about the influence of deep freezing on seeds on seed germination and plant development is essential to design of cryogenic storage technology. We tested the effect of cryoconservation on in-laboratory germination of seeds in some plants of the Kuril Islands and Kamchatka Peninsula: *Arnica unalaschcensis* (Urup), *Cardamine regeliana* (Brat Chirpoev, Harimkotan), *Cardaminopsis lyrata* (Urup), *Cochlearia officinalis* (Harimkotan), *Epilobium cephalostigma* (Kunashir), *Montia fontana* (Urup), *Papaver miyabeanum* (Brat Chirpoev), *Persicaria maculata* (Kunashir), *Plantago camtschatica* (Urup), *Potentilla fragiformis* ssp. *megalantha* (Shumshu, Urup), *Rhododendron aureum* (Urup), *Sagina maxima* (Brat Chirpoev), *Stenotheca tristis* (Harimkotan), *Veronica americana* (Urup), *Potentilla vulcanicola* and three saxifrage species – *Saxifraga calycina*, *Saxifraga funstonii* and *Saxifraga nelsoniana* from Central Kamchatka, Ostriy Tolbachik volcano, *Sedum telephium* var. *purpureum* (Central Kamchatka). The seeds were frozen by direct immersion in LN for 30 days, and then they were thawed at room temperature and germinated at 22°C. The response of the seeds to the LN storage has been shown to be species-specific. The freezing did not affect the viability of the seeds as compared with control in 14 species, it allows to improve germination capacity of seeds in *Persicaria maculata*, *Rhododendron aureum*, *Saxifraga calycina* and *Sedum telephium*. Response to LN exposure appeared as decrease of germination in *Epilobium cephalostigma* and *Veronica americana* seeds. Results obtained suggest that cryogenic storage of the seeds is potentially very useful method to conserve wild plants genetic resources.

Dendroindication of Changes of Wood-Growth Conditions in Volcanic Regions of Kamchatka and the Possibilities of Their Prognosis

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Н.В. Ловелиус, В.Д. Дмитриев. Дендроиндикация изменений лесорастительных условий в вулканических районах Камчатки и возможности их прогнозирования

Kamchatka is a region of intensive volcanic processes influencing the vegetation. Eruptions of volcanoes in historical time are cyclic (for example, in 26 years for volcano Klyuchevskoi). The annual data on tree-ring growth for larch (years 1770-1968) and Chosenia (years 1899-1986) and the influence of volcanic eruptions and solar activity on the growth are considered. The diminution of the growth before, at the period and after strong eruptions is discovered; the complete restitution of rate of tree-ring growth takes place in 13-14 years after the eruption.

The activity of the Sun in a 22-year cycle predetermines most considerable changes in the annual tree-ring growth and their recurrence in dates of eruptions of volcanoes. In the course of an 11-year solar cycle the amplitude of changes of tree-ring growth is less significant.

If the experts' prediction of the global warming of the climate with subsequent change of the oceans' level proves to be correct, it can affect maintenance of biodiversification of ecosystems land - sea. Therefore adoption of dendroindication for the scientific prognosis will be required for the safe development of natural resources of Kamchatka. A creation of an international bank of dendroindicational data is proposed together with scientific interaction in estimating of changes of natural medium in regions of intensive volcanic processes of Kamchatka and of the Pacific volcanic ring.

Seedling Dynamics and Habitat of *Larix kaempferi* on Disturbed Area by Snow Avalanche Around Timberline of Mt. Fuji, Central Japan

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Е. Минами, А. Мисуми, М Насимото. Динамика подроста и местообитания *Larix kaempferi* в разрушенных снежными лавинами районах близ верхней границы леса на вулкане Фудзи (Центральная Япония)

Mt. Fuji is the typical stratovolcano with alt. 3776 m a.s.l. Ground surface of Mt. Fuji is consisted by cellular gravel materials called scoria and parent rock. Indeed, the stability is quite low that snow avalanches are liable to occur, frequently. *Larix kaempferi*, pioneer woody plants, is growing commonly on the unstable area around timberline. The disturbance by snow avalanches has influence on regeneration and species composition in the area. The purpose of this study is to clarify the process in development of vegetation, especially we pay attention to the dynamics of seedlings of *Larix kaempferi* and its surrounding environment which influence directly or indirectly to the growth on disturbed area by frequent snow avalanches and undisturbed area around timberline. We set 3 quadrates (10 × 10 m) on each area, and also set 20 sub-quadrates (50 × 50 cm) in the quadrates where the seedlings appeared. We measured exposure rate of scoria, and cover of litter and vegetation (percentage), in order to reveal the favourably factors for establishment and growth of the seedlings.

As the result, we recognized those three points. 1) Tree species consisted patchy or scrub forest were different in each area, though those forests existed at same elevation. In the disturbed area by snow avalanches, few tree species were observed and also no seedlings. 2) In the edge of the forest, many seedlings were found. 3) In *Alnus crispa* ssp. *maximowiczii* and *Betula ermanii* dominant forest, smaller number of seedlings of *Larix kaempferi* was found in only some open-canopy sites by fallen tree than the edge of the forest.

Photosynthetic and Water Use of Two Co-occurring Polygonum Species at a Scoria Desert of an Altitudinal Timberline of Mt. Fuji

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Т. Накано, А. Танака, Т. Отсука, Е. Абэ, Х. Танабэ, Я. Ямамура. Фотосинтез и водообмен двух совместно произрастающих видов Polygonum на шлаковой пустыне на верхней границе леса вулкана Фудзи

In upper timberline of Mt. Fuji, basaltic scoria desert spreads in a great extent, and only a few species can establish such a volcanic scoria desert. *Polygonum cuspidatum* (Pc) and *Polygonum weyrichii* (Pw) are well known as pioneer species around alpine timberlines of Mt. Fuji. Pw has deeper and thicker tap root and thicker stem. The growing season of Pw is one month shorter than that of Pc.

The diurnal changes of net photosynthetic rates (Pn), leaf conductances to water vapor (gleaf) and leaf water potentials (XPP) were measured on a mid summer day (Jul. 25), a late summer day (Sep. 5) and an autumn day (Sep. 28). The relationships between inter-cellular CO2 concentration (Ci) and Pn were also measured. Water relational parameters were obtained from the Pressure-Volume analysis (the PV curve). Pw has higher gleaf than that of Pc. Pw maintains high Pn by opening stomata. The longer growing season in Pw will be important for photosynthetic production of this species.

As the gleaf was higher in Pw than that in Pc, transpiration rate was higher in Pw than that in Pc. Little differences were observed in daily pattern of XPP between the species. Higher water loss from leaves in Pw caused by higher gleaf might be supported by higher soil-to-leaf hydraulic conductance. The minimum values of XPP in daytime were nearly turgor loss point in both the two species. As the leaf water relational parameters obtained from PV curves were not differed between species, the ability of leaf drought tolerance was not differed between species.

These facts indicate that Pw, having shorter growing season, maintains high Pn by opening stomata that was supported by high soil-to-leaf hydraulic conductance guaranteed by morphological characteristics such as deeper and thicker tap root system and thicker stems. In contrast, Pc maintains high Pn by having higher ability of photosynthesis in lower Ci. The longer growing season in Pw will be important for photosynthetic production.

The Comparative Analysis of Southern and Eastern Kamchatka Hot Spring Flora and Vegetation

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В.Ю. Нешатаева. Сравнительный анализ флоры и растительности горячих источников южной и восточной Камчатки

The floristic composition and the structure of the thermophilous plant communities and aggregations of 7 hot spring areas have been studied at the South Kamchatka Nature Reserve (Southern Kamchatka) and the Kronotsky Nature Reserve (Eastern Kamchatka). The species diversity of the Kronotsky Nature Reserve thermophilous vegetation (5 hot spring areas were studied) was represented by 120 vascular plants including only 6 obligatory thermophilic species: *Ophioglossum thermale, Fimbristylis ochotensis, Lycopus uniflorus, Stachys aspera, Carex oxyandra* var. *pauzhetica, Spiranthes sinensis*.

The plant cover of two hot spring areas at the territory of the South Kamchatka Nature Reserve was characterised by 78 vascular plant species of 25 families. It was found that 10 species occured at the thermal field areas with the soil temperature from 50°C to 70°C: *Carex appendiculata, Carex oxyandra* var. *pauzhetica, Oreopteris quelpaertensis, Lycopus uniflorus, Agrostis pauzhetica, Calamagrostis purpurea, Trientalis europaea, Artemisia opulenta, Cirsium kamtschaticum, Glyceria alnasteretum.* Only 3 of them were considered to be obligatory thermophilic (*Agrostis pauzhetica, Lycopus uniflorus, Carex oxyandra* var. *pauzhetica*).

The floristic composition of the thermal sites was mainly formed by plant species of the neighboring vegetation with the exception of several stenotopic thermophilic species. The thermophilous community types considerably depended on the latitudinal zone, the altitudinal belt, the climatype and the chemical composition of the hot spring water and substratum.

A New Vegetation Map of Mt. Etna (a Volcano in Southern Italy)

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Э. Поли-Марше. Новая карта растительности вулкана Этна (южная Италия)

As vegetation maps give information about the plant cover of an area at a particular time, they are particularly precious documents when they regard an active volcano which is subject to continual changes.

The first map showing the vegetation on Etna was realized by this author et al. about 20 years ago. Given that in the last 20 years there have been more than 10 new lava flows it was considered necessary to draw up a new map. We have therefore done this and the new map is completely different from the old one, also because of the criteria adopted in the final drawing up.

The aim of this work is to present the new map. It was realized on the basis of numerous geobotanical surveys – mainly carried out with a phytosociological method – and with the help of photo-interpretation. The cartographic types were defined also taking into consideration physiognomic and structural aspects of the vegetation and its dynamics.

The map, in colour, makes it possible to see the different altitudinal belts of the vegetation, within which different structural types of vegetation – interpreted according to their dynamics – can be identified. Among the principle structural types, also open formations can be identified. It is easy to see the new lava substrates, which host various stages of plant colonization. Special symbols mark sites worthy of attention for their ecological and biogeographic significance or their importance for scientific or environmental education purposes. The detailed illustrative text on the back of the map makes it easier to understand.

This map, showing as it does the present plant distribution in a continually changing volcanic territory, represents a useful tool for the management of the territory in the Mt. Etna Natural Park.

Active Explosive Volcanism Impact on Late Pleistocene Palaeolandscapes of Southern Kunashir Island, Kuril Islands

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Н.Г. Разжигаева, Л.М. Мохова. Влияние активного вулканизма на позднеплейстоценовые палеоландшафты южной части острова Кунашир (Курилы)

Active explosive volcanism controlled the development and evolution of South Kunashir landscapes at second half of Late Pleistocene. Two major phases of explosive activity of Golovnin Volcano have been dated about 38-43 and 30-32 ka, calderaforming eruption of Mendeleev Volcano took place about 38-39 ka. Eruptions and following reworking of tephra led to formation of thick layer of deposits (Belozrsky Beds), composed of pyroclastic, fluvial, proluvial, lacustrine, and swamp facies. The peat bogs, developed at the time of decreasing of volcanic activity, indicate the phases of vegetation development.

Phase of development of dark-coniferous forests and swamps within drained shelfs occurred at 38-48 ka ago. *Picea glehnii* became the main component of the coniferous forests on Pacific coast, and *Picea ajanensis* – on the Okhotsk Sea coast. At present similar dark-coniferous forests are developed on the North Kunashir and South Iturup. Role of birches increased at the middle of this phase. Coniferous forests were completely destroyed around the volcanoes at the beginning of eruptive phase, and *Pinus pumila* plays a primary role in the pollen assemblage.

Phase of open-woodland birch forests with wide development of Alnus and swamp assemblages with Cyperaceae, Ericaceae, and Ranunculaceae on lowlands indicates climatic deterioration and high humidity. Development of *Pinus pumila* wasn't connected with timberline shift and reflects the distribution of pioneer vegetation on tephra, and composed thick alluvial-proluvial train around Golovnin Volcano.

Phase of broad-leaved forests reflects the distribution of woodlands with Quercus, Juglans, Acer, Fraxinus, Carpinus, Syringa and birches. High content of herb pollen indicates the development of grasslands with Gramineae, Artemisia, Compositae, and Cyperaceae on wetlands. The pollen spectra corresponds to Last Interglacial, because about 31 ka Hokkaido was occupied by coniferous forests with birches.

Phase of open-woodland birch forests with some conifers and plots with shrub birches and Alnaster is divided at the end of Late Pleistocene. Pollen spectra was received from buried soil of eolian sandy loam, covered Belozersky Beds.

So, the deposits record two warmings within South Kurile region at 48-38 ka and about 30 ka, divided by well pronounced cooling. Weak cooling about 41-46 ka did not cause major landscape changes. Volcanogenic successions, connected with intensive eruptions, play primary role in vegetation changes on a background of climatic changes.

Diversity of Andisols on the Kamchatka Peninsula

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С.А. Шляхов. Разнообразие андосолей на Камчатке

Andisols are located directly in the places of recent volcanic activity along the eastern coast of the Kamchatka peninsula are studied. Significant amounts of volcanic ejecta (ash, pumice, cinders etc.) fall repeatedly on the surface of the soils from the atmosphere. Therefore, marks of pedogenesis in their profiles are expressed less than the lithological stratification. In the Russian soil classification such substrata named as volcanic ash stratified soils.

In 1998 the two locations were studied: 1) area near Karymskiy volcano; 2) Tolbachik Dol related to the Kluchevskaya volcanic group.

Andisols found close to volcano Karymskiy consist of the layers of igneous material (black and light-gray to whitish) and buried O and A horizons. Bottom parts of soils have typical grayish-brown color, which disguise soil's stratification. The morphological properties permit to distinguish Andisols of tundra, meadow, Pinus pumila and dwarf alder thickets, wetlands (near Karymskaya river), young lava flows with primary vegetation and geothermal fields (with active geysers). The last kind of soils is differed from other soils of this territory by much finer texture, much lesser expressed stratification and uniform color of profile. In terms of Soil Taxonomy most pedons are Cryands with the exceptions of Andisols with aquic conditions (Aquands) and soils of geothermal sites.

In the Tolbachik Dol soil pits were opened in several sites along a transect between the North Vent and the South Vent of the split eruption 1975 - 1976. Larch forest occupied this territory recently. It was partly exterminated, partly damaged by the eruption. Forests soils were buried by tephra. Examined soils consist of layers of igneous material (black and light-gray to whitish) and buried A and AC horizons. The thickness of the surface tephra layer decreases southward from 238 to 20 cm. Soils on young lava have very simple profile structure. AC horizon underlied by lava boulders occurs beneath the recent cinder layer.

Biomass, Net Primary Production and Chronological Change of Carbon Storage of a *Pinus densiflora* Forest Established on a Lava Flow of Mt. Fuji, Central Japan

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Х. Танабэ, Е. Абэ, Т. Отсука, Т. Накано, С. Марико. Биомасса, первичная продуктивность и временная изменчивость запасов углерода в лесах *Pinus densiflora* сформированных на лаве вулкана Фудзи (Центральная Япония)

Pinus densiflora Sieb. et Zucc. is a woody species that occurs in the early stages of primary succession. To determine how *Pinus densiflora* can dominate on new substrates, we assessed above- and belowground biomass, net primary production (NPP) and chronological change of carbon storage (growth of woody parts and leaf production on a carbon basis) in a mature *Pinus densiflora* forest established on a lava surface of Mt. Fuji, central Japan. Soil profiles suggest that this forest is the first to be established on the lava field in primary succession. The soil depths were only 7.5-29.0 cm. The mean percentages of the total nitrogen and total carbon of the dry weight of the soils were 0.83 % and 40.11 %, respectively. Total biomass was 232.78 Mg ha^{-1}, of which 70 % was in the stems and 24 % was in the roots. The fine root biomass was 1.28 % of the total biomass. Recent total NPP of the forest reached 10.02 Mg ha^{-1} $year^{-1}$, which corresponds to values reported for other cool temperate pine forests on mature substrates. Carbon storage slightly increased as the stand age increased from 30 to 85 years. The fine root production was about 46 % of the total NPP, a value that is relatively small in view of the high soil C/N ratio (48.95). The pine trees appear to utilize mineral nutrients taken up by associated mycorrhizae. The relatively high total NPP, the small root/shoot ratio and maintenance of carbon storage in spite of the high soil C/N ratio suggest that the pine trees have an association with mycorrhizae.

The Life Strategy of *Pennellianthus frutescens* (Lamb.) Crosswhite (Scrophulariaceae) in Colonization of Materials of Volcanic Eruptions

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В.П. Верхолат. Стратегия Pennellianthus frutescens (Lamb.) Crosswhite (Scrophulariaceae) в освоении материалов вулканических извержений

The populations of Pennellianthus frutescens were studied in August 2000 on the slopes of volcano Chikurachki (Isl. Paramushir) in the scopes of project "Influence of the biggest eruptions of Kurils and Kamchatka on vegetation" supported by NGS. For the first time the qualitative and quantitative characteristics of the main age stages (juvenile, immature, vegetative and generative) and their variants were obtained.

We studied the age structure of several populations of Pennellianthus on the eastern slopes of volcano with 1986 tephra layer thickness ranging from 17 to 27 cm. The stage of active invasion of the species on the free of vegetation substrates is characterized by prevailing of younger plants at juvenile, immature and early vegetative age stages. At the moment, when the roots reach buried soils, the intensive increase of aboveground biomass (increasing of number of shoots and its height) was observed. The portion of younger shoots is decreased and generative individuals dominate in populations. The increase of clones in size and their closing leads to the formation of monodominant communities. Fastening of tephra takes place due to the branchy main root with well developed systems of supplementary roots. The aboveground shoots prevent the tephra blowing out and accumulate organic material within an area covered by individual. With the colonization of another plant species the clone may split into the several clones. As the cover of alien plants increases, Pennellianthus cannot resist the shade and disappears from new formed communities.

Because of the fast root growth, Pennellianthus behaves on barren unstable tephra as an active pioneer species promoting the substrate stabilization and improving conditions for colonization of tephra deposits by new species.

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