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The Biogenic Mineralization in Plants

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Approximately 20 biogenic minerals (bioliths) were known in plants (Korago, 1992). Examining conditions of forming biominerals in plants it is necessary take into account that in their tissues take place the restoration conditions - the biogenic restoration barriers in ways of biogeochemical migration of elements from environments in plants and inside plants. During decomposition of plants their transformed or not transformed by oxidation processes bioliths are entered in small biological and in great geologic rotation. Because of this bioliths are presented always in soils, bottom sediments of water drains, lakes, seas, oceans, and of course in sediments. They may be diagnosed in mineralogical investigations as minerals of indefinite or erroneous genesis. By publications and our data bioliths are known for 34 chemical elements: Cu, Ag, Au, Be, Ca, Mg, Zn, Cd, Hg, Al, C, Si, Ti, Zr, Pb, P, As, W, O, S, Se, Mn, F, Cl, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt. Three physiological functions of bioliths in plants may be discussed. 1) The participation in the mechanisms of nonbarrier-barrier accumulation of chemical elements in various plant organts, tissues, cells and subcell structures. 2) The storing of some chemical elements in winter period of the relative physiological immobility for the intensive consumption in the summer period of intensive vegetation. 3) The active participation of corresponding chemical elements after dissolution of the accumulated bioliths in physiological processes in summer and autumn phases of intensive growth, development and fruit-bearing. The first function of bioliths is characteristic for "old", died, low-active and inactive tissues. It is connected with the transferring of the excessive quantities of chemical elements in the physio-logically inactive forms of solid phase - bioliths. This function is established and investigated by us in suberized covering tissues (bark) of trees trunk and in their fruits - in suberized cones of coniferous trees for example. We establish that the process of suberinization in such tissues is accompanied by the nonbarrier increasing contents of the definite complex of chemical elements. Na, Al, Si, Ti, Zr, Pb, V, Fe, Co, Ni, Li, Be, F are related for them. The maximal, 100-20 times increasing of contents is established (in order of diminishing) for Be, Li, Zr, Si, Al, F, Ti; very significant - 15-5 times, 10 times in average - for, Pb, Ag, Cr and significant 4-2, 3 times in average - for Ni, V, Cu, Na, Yb, Ga, Co, Mo, Sn. Easily determined bioliths with sizes to 0.01-0.1 mm are presented in heavy fraction of pines trunk bark - named phytoshlichs (Kovalevskii, 1992). It is concerned the majority of the first group chemical elements (Be, Zr, Si, Al, F, Ti), approximately one half of second group (Fe, Pb) and even some elements of the third group elements, Na for example. This in-creasing of contents in suberized nonbarrier tissues in comparison with the corresponding unsuberized barrier tissues testify about a significant intensity of this biogenic mineralization. The investigations of green and suberized cones of *Pinus silvestris* show that this mineralization take place rather quick - during 1-3 months when green cones change into suberized ones. These data may give conclusion that the process of suberinization is accompanied by intensive biomineralization. The interesting but low investigated mechanism of the chemical elements nonbarrier accumulation is the forming of bioliths <1 mkm size on the cell surfaces - on cell membranes of physio-logically active tissues: leaves, sprouts, stems, etc. It was established by Malone et. al. (1974) in leaves, stems and roots of the corn for lead in the forms of lead phosphate and lead pyrophosphate. Similar process is known for uranium and is probable for many other chemical elements. The storing of chemical elements is well illustrated by forming of the calcium oxalate $Ca(COO)_2$ crystals significant quantities in physiologically active sprouts and leaves of trees. It is described in thousands of publications. There are foundations to suppose that oxalatization is accompanied by the forming of other chemical elements bioliths, the native gold for example. The presence in twigs and sprouts the significant quantity microbioliths of gold was established by us first with help of the high sensitive scintillation emission spectral analyses. The microbioliths of native gold were revealed some years later by mineralogical investigations with roentgen micro-analyses. The analogical investigations are necessary for other bioliths and processes of bioliths-forming - carbonatization and phosphatization for example. The data about coincided in time dynamics of quantity and sizes of the calcium oxalate bioliths and the native gold microbioliths show that their contents in physiologically active, growing organs and tissues is one of the physiological processes. It is evident that these data need special monitoring investigations as during the life of separated organs and tissues, so during all time of perennial plants vegetation. The dissolving in summer of bioliths accumulated in winter period of relative physiological immobility is one of the testimony that the most active ionic forms of the corresponding chemical elements arose from the bioliths take place in the determined physiological processes of the vital-functioned plant tissues. The known data about significant dynamic during time contents of gold in twigs and leafs (Kovalevskii, 1991 in Russian) are in correspondence with the statement that gold (and silver) is chemical element favorable for plants, animals and humans (Buryak et. al., 1993). What are the physiological mechanisms of this favorable action and the role of bioliths in them must be the aims of special investigations. It is evident that it is related to all bioliths-forming chemical elements. The discussed preliminary data about bioliths and microbioliths of plants and their physiological role need combination of mineralogical investigations with biogeochemical, botanic, phenologic, physiologic and other ones. It is necessary to organize such complicated complex of investigations with co-operation of the Russian Academy of Sciences some institutes and also Russian and foreign universities with the financing from the Russian Foundation of Fundamental Investigations and foreign Foundations.