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Cadmium Detection in the Biosphere in Bio-Bio Area, Chile

M. Alarcón, G. Cea and A. Rodríguez

Department of Molecular Biology, Faculty of Biological Science and Natural Resources, University of Concepción, Casilla 2407. Concepción. Chile

High concentrations of cadmium in the biosphere of some world areas as product of human industrial activity have been detected (Yamagata, 1979 and Kjellström, 1979), with the highest levels in centers that produce paints with cadmium, lead, zinc and other pigments (Bauchinger et al. 1976; Gale and Wixson, 1979).

On the other hand, more subtile situations increase cadmium concentration in biological systems and mainly in human beings. Bentonic marine flora and fauna concentrate this chemical in several areas (Yamagata et al. 1975; Frasier, 1979; Engel and Fowler, 1979), which, through biological cycles reaches man. Thus populations that mainly feed on seafood show higher cadmium contamination indexes than populations with a more varied diet (Schroeder and Balassa, 1961; Kjellström, 1979).

Cadmium determination in the biosphere of Bio-Bio area, Chile (36°-38°30'S, 71°-73°30'W) is a part of the integrative study of the action of this element as contaminant in a highly industrialized area, and as a potencial mutagen, carcinogen and/or teratogen on the living organisms of this area.

In the Bio-Bio, besides being a by-product of industrial contamination, cadmium may also originate in fertilizers containing phosphates used in crops, as they have a fossil-marine origin, which is characterized by high cadmium impurities (Shroeder and Balassa, 1963).

MATERIALS AND METHODS

In order to determine cadmium its levels of concentration in the biosphere in the Bio-Bio area, in abiotic sources, and when going into the biological cycles, representative samples were taken and subjected to analytical determinations by atomic absorptimetry techniques.

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An atomic absorption spectrophotometer Perkin-Elmer, Model 305, was used. The instrumental conditions (wavelength, slit, gas flow, etc.) correspond with those given by Perkin-Elmer Corp., 1968. The technique has a sensibility of 0.04 µg/ml by 1% absorption and its limit determination is 0.004 µg/ml.

RESULTS AND DISCUSSION

80 abiotic samples and 160 biotic samples were processed. Only 12 samples were positive (Table I).

Table I. Cadmium positive detection in the biosphere in Bio-Bio Area, Chile (36°-38°30'S, 71°-73°30'W.)

Species	Site	Date	Concentration mg/kg
Arable land I	Matadero River Hualqui	8-11-78	30
Arable land II	Araucana River Hualqui	8-11-78	20
Ambrosis chamissonis, Levyns.	Playa Blanca	19-10-79	110
Francoa appendicutata Cav.	Hualqui	15-11-78	20
Pisum sativum L.	Arable area, Hualqui	15-11-78	10
Calceolaria cana Cav.	Bio-Bio mouth	23-11-78	30
Chamonilla recutita (L) Rauschert.	Bio-Bio mouth	23-11-78	13
Artotheca calendula (L)	Bio-Bio mouth	23-11-78	10
Ulva lactucca (L)	Dichato	23- 4-79	1
Odontesthes regia (Humbolt, 1833	Penco	23- 4-79	2
Sea-water	Dichato	23- 4-78	0.1 mg/l
Fresh water	Carampangue River (Bridges to Arauco)	1- 3-79	1.05 mg/l

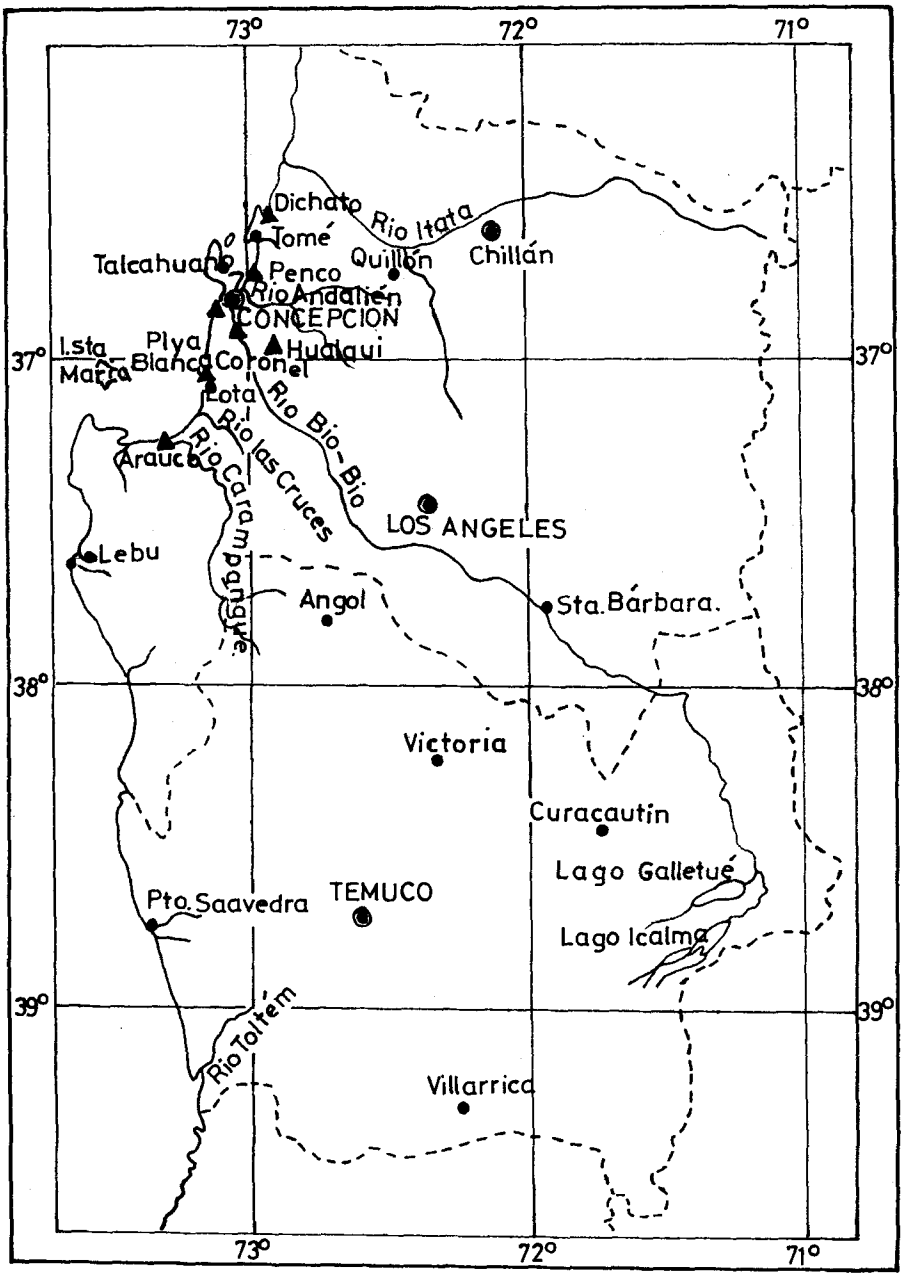

Fig.1– BIO BIO river area. CHILE.

▲ = Cadmium detection zone

From the analysis of the abiotic and biotic samples from the Bio-Bio area, Chile (36°-38°30'S, 71°-30'W) (see map fig. 1) we can conclude that cadmium contamination is still low, in spite of being one of the most industrialized coastal areas and that the arable land of the central valley is traditionally fertilized with superphosphates are as rich in phosphates as in cadmium (Schroeder and Balassa, 1963).

It can be noted that in the geographic places where it was detected, its presence was always in low concentrations. This lead us to assume that the washing of the soil and the strong currents of the rivers carrying the residues to the sea, may rapidly eliminate a low and/or occasional contamination. This phenomenon, however, would present this chemical in a higher concentration in the coastal area; detectable in sea water and bentonic flora and fauna, which have a tendency to concentrate oligoelements, a reported for other areas (Tsuchiya, 1978; Frazier, 1979; Engel and Fowler, 1979). But this was not the case in this area.

Cadmium detection in some native flora species indicates that mechanisms would exist in them which concentrate cadmium; ranging from traces up to atomic absorptiometry detectable levels (0.004 µg/ml).

This values indicate that the Bio-Bio area, Chile does not yet show a relevant contamination with this metal, which can be classed as a non-essential oligoelement in living organisms because it is toxic and has not been detected as an integral element of a coenzymatic factor.

REFERENCES

Bauchinger M, Schmid E, Einbrodt HJ, Dresp J (1976) Chromosome aberration in lymphocytes after occupational exposure to lead and cadmium. Mutation Research 40: 57-62
Engel DW, Fowler BA (1979) Factor influencing cadmium accumulation and its toxicity to marine organism. Environ Health Perspect 28:81-88
Frazier JM (1979) Bioaccumulation of cadmium in marine organism. Environ Health Perspect 28:75-79
Gale NL, Wixson BG (1979) Cadmium in forest ecosystems around lead smelters in Missouri. Environ Health Perspect 28:23-27
Kjellström T (1979) Exposure and accumulation od cadmium in population from the United States and Sweden. Environ Health Perspect 28:169-197
Perkin-Elmer Corp. (1978) Analitical methods for atomic absorption spectrophotometry
Schroeder HA, Balassa JJ (1961) Adnormal trace of metal in man. J. Chron Dis 14(2):236-258
Schroeder HA, Balassa JJ (1963) Cadmium uptake by vegetables from superphosphate in soil. Science 140:819-820
Tsuchiya K (1978) Cadmium studies in Japan. A review. Kodansha Ltd. Tokyo. Japan

Yamagata N, Iwashima K, Hashimoto T (1975) Determination of cadmium in sea-water by neutron activation. Bull Inst Publ Health 24(3):143-149
Yamagata N (1979) Cadmium in the environment in Japan. Recent Progress of Natural Sciences in Japan 4:93-101

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