

Electrophoretic investigations of the behaviour of ^{65}Zn in sea water, sea water-EDTA systems and NaCl-EDTA solutions

by

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The biogeocycle of radionuclides introduced into the seas and oceans is closely related to their physico-chemical behaviour in the sea water [CHIPMAN, 1966; KEČKEŠ *et al.*, 1966; KEČKEŠ *et al.*, 1967; CHIPMAN *et al.*, 1968]. Various techniques were used to study this problem [MARAZOVIĆ & PUČAR, 1966; BILINSKI & BRANICA, 1966; FUKAI & VAS, 1967; BARIĆ & BRANICA, 1967; MARAZOVIĆ & PUČAR, 1967; FUKAI & HUYNH-NGOC, 1968] and here some experiments concerning the influence of EDTA on the behaviour of ^{65}Zn in sea water will be described.

Experimental and results

Electrophoretic experiments were performed as described earlier [PUČAR, 1957].

The experimental conditions were : basic electrolyte, Millipore HA (0.45 μ) filtered sea water of salinity 37 ‰ or 0.55M NaCl with or without EDTA added and pH adjusted to 8.00; filter paper, Munktell 20/100; free length and width of filter paper strips, 66 \times 1.5 cm; 1100 V and 21-24 mA per one strip; duration of electrophoresis, 72 minutes; temperature 21°C.

Solutions of ^{65}Zn were prepared from the original solution of carrier-free ^{65}Zn in 1 M HCl (Amersham) by evaporation to dryness and by adding the corresponding solutions of sea water or the NaCl solution, with or without addition of EDTA to the residues.

The concentration of ^{65}Zn in NaCl solutions was about 10^{-7}M . This corresponds to the concentration in the electrophoretic zone to $2 \times 10^{-8}\text{M}$ ^{65}Zn . The concentration of inactive Zn in sea water was about $2 \times 10^{-6}\text{M}$.

The behaviour of ^{65}Zn was followed by measuring the electrophoretic mobility of the carrier free ^{65}Zn in dependence on the concentration of EDTA and on aging of the systems in the time interval from 0 to 10 days. The electrophoretic mobilities were given in/mm Volt $^{-1}$ hour $^{-1}$ cm/ and were corrected as described earlier [PUČAR, 1957].

The electrophoretic mobilities of ^{65}Zn in sea water-EDTA systems are presented in Fig. 1 as a function of the logarithm of the concentration of EDTA from 10^{-6} to 10^{-2}M , and at different aging times 0 to 10 days.

Above the zero mobility line ^{65}Zn is found to be present in the anionic form, while below the zero line it is present in the cationic form. The vertical lines in the diagram represent tailing of electrophoretic zones of ^{65}Zn .

In Fig. 2 the electrophoretic mobilities of ^{65}Zn in NaCl-EDTA systems are presented in the same manner as in Fig. 1.

Discussion

Depending on the concentration of EDTA in the systems, ^{65}Zn behaves in three characteristic ways. At concentration below 10^{-5} M EDTA ^{65}Zn behaves in sea water as a cation, at the time 0 its electrophoretic mobilities are almost the same as in the pure sea water, however, the cationic mobilities show a slight decrease after 24 hours of aging of the systems and remain constant until the 10th day. Though in this concentration range of EDTA well defined cationic zones of ^{65}Zn are found there is also some tailing of the electrophoretic zones in the range between 2.1×10^{-6} and 10^{-5} M EDTA.

Above 4.6×10^{-4} M EDTA ^{65}Zn shows a well defined anionic zone with constant electrophoretic mobility.

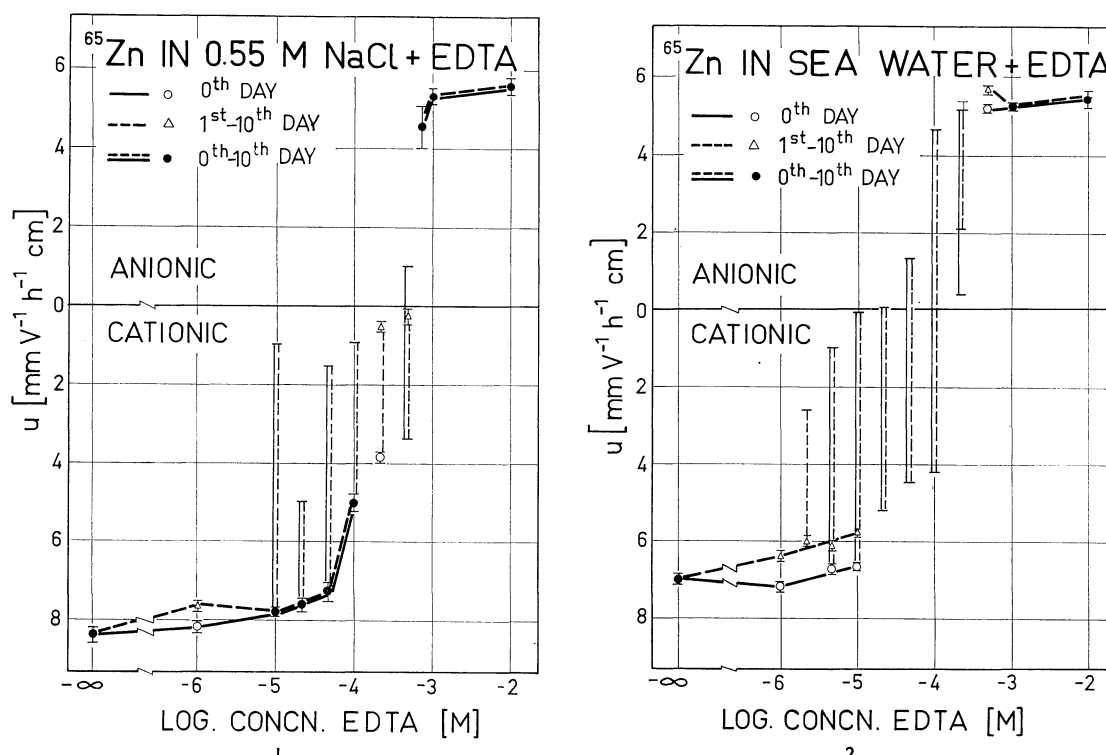


FIG. 1. — Electrophoretic mobilities of ^{65}Zn in sea water-EDTA systems as a function of the logarithm of the concentration of EDTA. Salinity of sea water is 37 ‰. Note the effect of aging of the systems. For further explanations see text.

FIG. 2. — Electrophoretic mobilities of ^{65}Zn in 0.55 M NaCl-EDTA systems as a function of the logarithm of the concentration of EDTA. Note the effect of aging of the systems. For further explanation see text.

Between 10^{-5} M and 4.6×10^{-4} M EDTA ^{65}Zn shows cationic and anionic tailing without distinctive electrophoretic zones. This indicates that in this region ^{65}Zn is not present as a stable and defined physico-chemical species.

In the NaCl-EDTA systems ^{65}Zn behaves as a cation up to 4.6×10^{-5} M EDTA, showing a slight decrease of the cationic mobility with respect to the cationic mobility in pure NaCl solution. There is also some tailing into anionic direction.

Above 6.9×10^{-4} M EDTA ^{65}Zn shows a well defined anionic zone.

Between 4.6×10^{-5} M and 6.9×10^{-4} M EDTA ^{65}Zn shows anionic and cationic tailing and gives no electrophoretic zones, this indicating that in the mentioned region ^{65}Zn is not present in a stable and defined physico-chemical form.

From the experiments carried out in sea water-EDTA systems and from those performed in NaCl-EDTA systems it is evident that ^{65}Zn exists in the cationic, and anionic form depending on the concentration of EDTA in the system. The effect of aging of the systems is significant only in the time interval from 0 - 24 hours.

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