Epithermal neutron activation analysis and X-ray computed tomography investigation of some scleractinian Red sea corals

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Alcyonaria (Octocorallia)

(soft corals, sea pens) colonial organisms, with numerous tiny polyps embedded in a soft matrix that forms the visible structure of the colony

Anthozoa

Zooantaria (Hexacorallia)

(sea anemones, stony corals, black corals) colonial or solitaire organisms, some of them with numerous tiny polyps embedded in a hard, calcareous matrix that forms colony and coral recifes

Tubipora musica

Ptilosarcus gurneyi

Dendronephthya klunzingeri

Corrallium rubrum

Actinia equina

Antipatharia sp.

Porites porites

Acropora cervicornis

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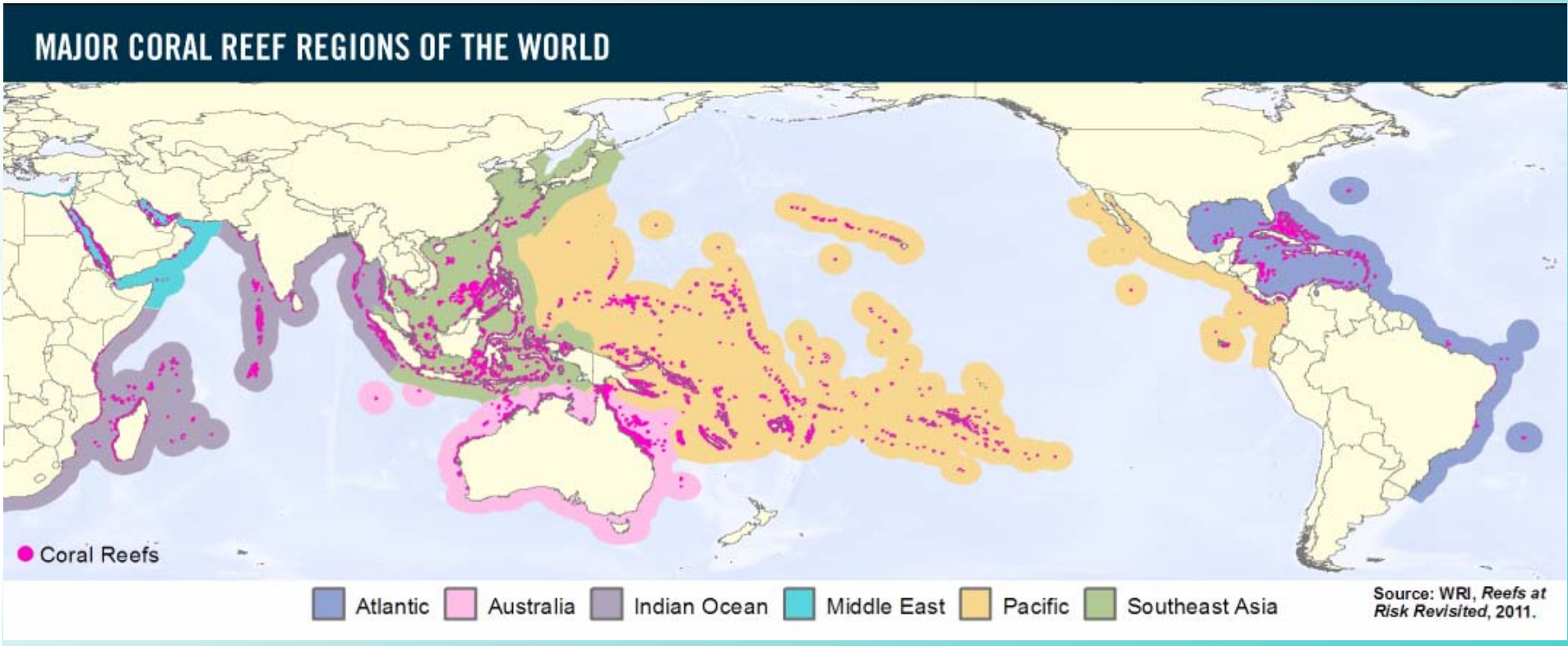

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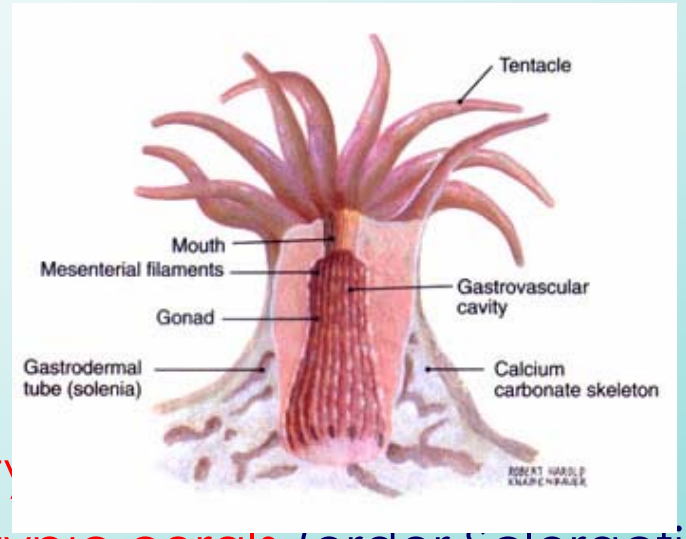
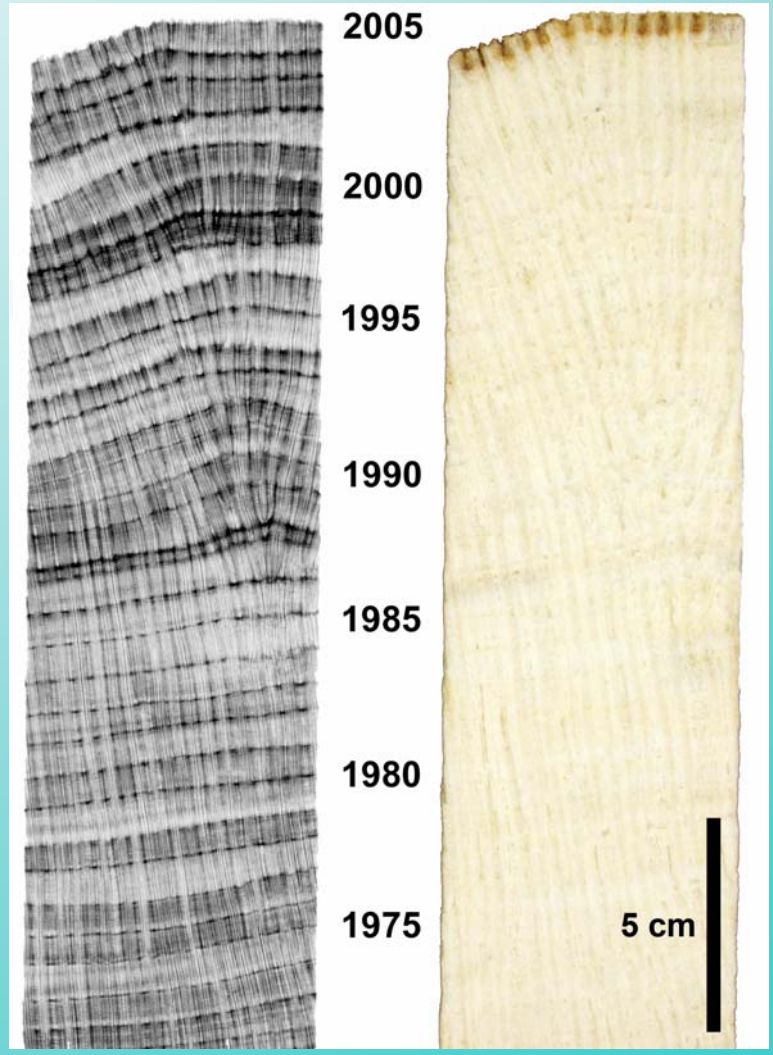
- Extremely primitive animals



- Hermat
- Hermatypic corals (order Scleractinia) build reefs by depositing hard calcareous material for their skeletons, forming the stony framework of the reef by growing annually



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The Red Sea is a relative younger sea, as it appeared about 40 Mo years ago, when the Arabian peninsula separated from the Africa plate, rotating counterclockwise, and thus separating from the African plate.

The geological history of the Red Sea region is distinctive, and there is only slow and restricted water (and larval) exchange between this sea and the remainder of the Indo-Pacific region as a whole.

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The Red Sea corals have developed an unusually high tolerance to the extreme temperatures, salinity, and occasional turbidity (caused by huge seasonal dust storms) that occur in the region. Such conditions that would be lethal or highly damaging to most hard corals found elsewhere.

The water clarity is exceptional in the Red Sea because of the lack of river discharge and low rainfall so that Red Sea reefs are not heavily impacted by the suspension and dissipation of fine sediments.

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About 300 hard coral species have been recorded from the Red Sea as a whole. The Egyptian coast alone supports about 200 species of reef building corals belonging to almost 50 genera. This represents about four times the hard coral diversity found on Caribbean reefs, and is comparable to the coral diversity found in the Maldives and Seychelles in the Indian Ocean.

Corals take both nutrients and carbon ions from the sea water to built the external hard skeleton whose composition is strong linked with the biota.

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Therefore, the chemical composition of the coral external skeleton reflects the changes regarding not only chemical composition but also the physical properties of the sea water where grow.

For this reason, within this common IUCN-Dubna-Cairo University-University of Bucharest we have investigated a number of hard (scleractinian) corals to evidence at which extent the elemental composition of their exo-skeleton could provide information regarding the media where they live.

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For this study, Summer, 2015, five different species of stony corals (colonial and solitaire) were collected in the vicinity of Kamran Island, off Yemen coast, at depth between 5 and 15 m.

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Lobophyllia sp.

Fungia sp.

Porites sp.

Stylophora sp.

Stylophora sp.

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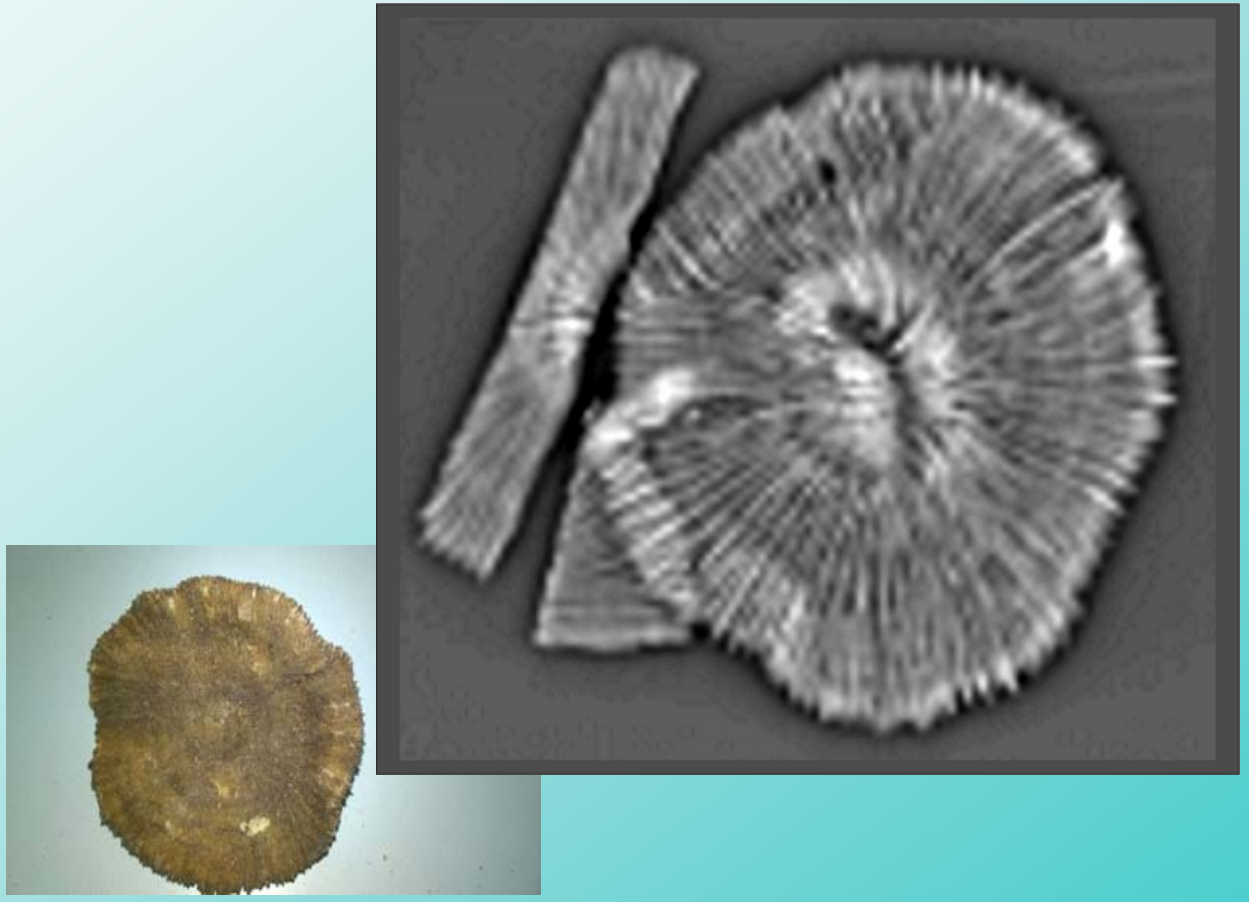
Each exemplar was CT investigated by means of a medical Siemens Somatom computed tomograph.



Fungia sp.

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Further, by means of a water saw, from each individual it was a slice of 1 cm thickness was removed, divided into two aliquots, one of them ground and homogenized by using an agate ball-mill, while the second one was exposed to acetic acid for 24 h, was washed with distilled water, placed in hydrogen peroxide (1N), washed again with distilled water and finaly dried and homogenized.

All ENAA were performed at the Activation Analyses sector of the FNPL of the JINR –Dubna.

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The purpose of such sample preparations was to determine where the metals are adsorbed:

- by the calcium carbonate exoskeleton or

-by the living polyps.

The acetic acid, which contained the "precipitate" after washing was dried and subject to NAA, too.

A total of 29 elements were determined in all three kinds of samples, *i.e.* native, acetic acid treated as well as the dried acetic acid supernatant.

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Element	Average	St.Dev.	Rel.St. Dev.	Element	Average	St.Dev.	Rel.St. Dev.
Na	3133	2333	74	Rb	1.0	0.4	64
Mg	2717	1752	64	Sr	5356	517	10
Al	1833	2062	112	Sb	0.0	0.0	53
Cl	2319	3280	141	I	8.0	7.3	91
Ca	340100	45305	13	Cs	0.0	0.0	59
Sc	1.3	1.8	142	Ba	34	57	167
Ti	459	399	87	La	2.0	2.3	112
V	4.4	4.3	97	Ce	5.0	5.2	99
Cr	20.4	9.8	48	Gd	1.0	0.8	99
Mn	57.2	65.6	115	Tb	0.0	0.1	126
Fe	3169	4284	135	Hf	1.0	1.1	109
Co	1.0	0.8	114	Ta	0.0	0.1	110
Zn	13.0	9.0	71	Th	1.0	1.4	122
As	1.0	0.6	89	U	3.0	0.3	12
Br	28.0	28.0	101	-	-	-	-

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The first preliminary results showed, as expected, Ca to be the dominant element with a total content varying between 32 and 36% in untreated samples and between 28 and 42% in the acid treated ones.

On the other hand, we have noticed a great variability regarding both the content of investigated elements and their ratio between acetic acid leached and unleached samples, with the exception of Na and Cl which content was always lower in the leached samples and U whose content practically was not affected by the acid leaching.

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Regarding U, it should be pointed out that its content was systematically about 2.7 mg/kg, *i.e.* those found in the Upper Continental Crust. As the U mean residence time is about 1 Mo years in the sea water, it is obvious that this element was included in the corals skeleton during organism growth.

This assumption is sustained by the content of other insoluble elements such as La, Ce, Th, Sc, ***etc***.also significantly lower.

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Moreover, as the PCA scatterplot illustrates, after acid leaching, all samples, with only one exception form the same cluster; this peculiarity illustrates some common traits regarding the elemental composition of the coral exoskeletons.

The numerical values of the distribution coefficients of the considered elements showed a great variability not only between elements but also between coral themselves, this fact illustrating in our opinion the diversity of habitats as well as of the coral genera in the southern Red Sea.

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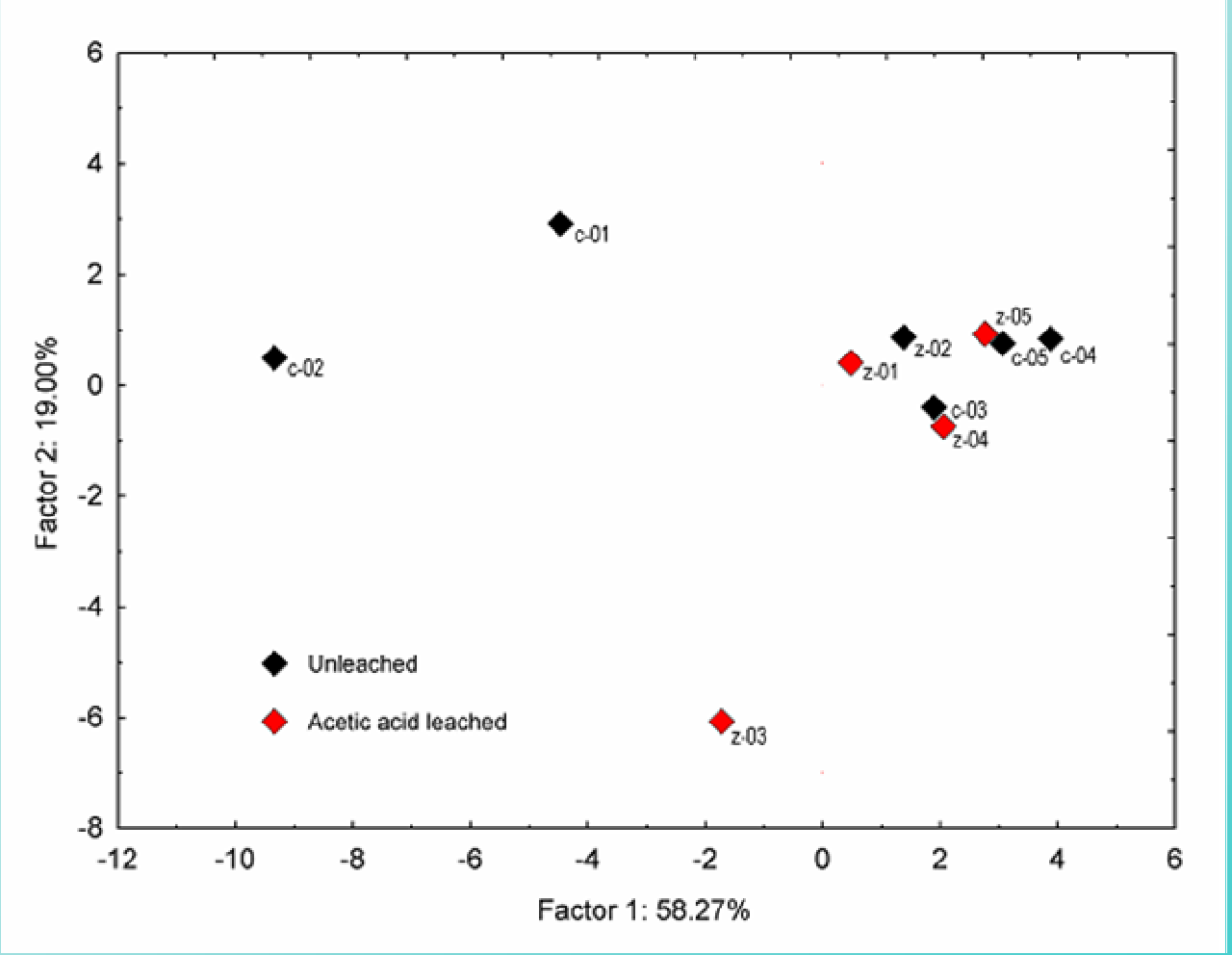
Final Statistica 11 Factor Analysis biplot



Thank You for Attention

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Спасибо за внимание