

Highlights of Analytical Sciences in Switzerland

Division of Analytical Sciences

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The Story of Pearls – An Elemental Perspective

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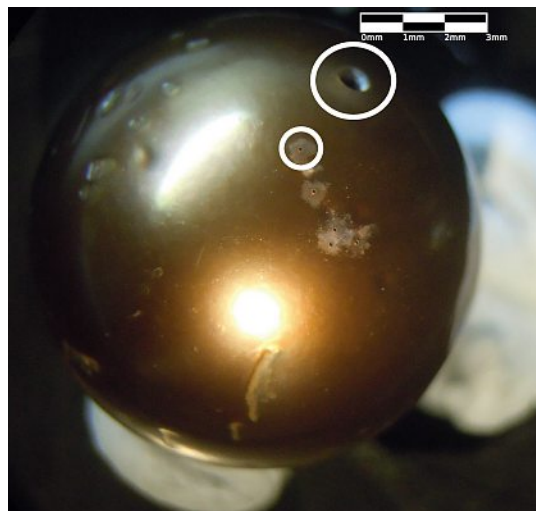
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Pearls are one of the important sectors in the gem market. They are originally a product in the shell of a mollusk. The cause of natural pearl formation was long attributed to small grains of sand or other dirt particles inside mollusks. Today a major reason for their formation is seen as a measure of defense due to enclosure of small intruding organisms. Before the 20th century, the demand of pearls was mainly satisfied by river pearls in Europe and the pearls of the Persian Gulf, also known as oriental pearls. In the 1910s the first pearl farms evolved and cultured pearls emerged on the gem market. The availability of cultured pearls in combination with the Great Depression led to a sharp drop in the price of pearls.

Besides being less expensive, cultured pearls also have the advantage of a more spherical shape and more desirable color or luster, depending on the growing conditions. The color can be altered in another step after the pearl is removed from the oyster. As this influences the prize of a pearl, it would be most valuable to have a method to distinguish between different origins and treatments of pearls.

In our study, we analyzed 110 cultured pearls from various origins by laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) and determined the concentration of 45 different elements. The concentrations were analyzed in dependence on water condition of culturing (sea/freshwater) and on the region of origin. For Ba, Mn, and P significant higher



An analyzed pearl from Tahiti. The tiny craters (middle) produced by the laser are small (60 μm) compared to the hole for the string of a necklace (ca. 1 mm) (top).

concentrations were found in freshwater pearls, whereas Na, K, Mg, B, S, and Sr concentrations are lower than in seawater pearls. However, a significant tracing back of the origin was not possible within this set of pearls.

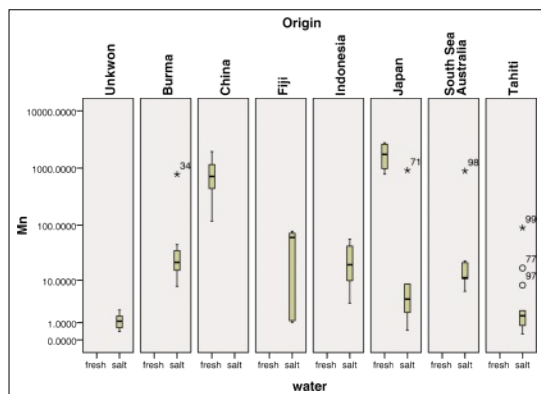
Additionally, elemental mapping was performed on a pearl cut in half, where growth rings could be seen.

LA-ICPMS has been shown to be a valid method for the distinction of seawater from freshwater pearls and to perform a mapping of concentration down to single rings from different growth periods.

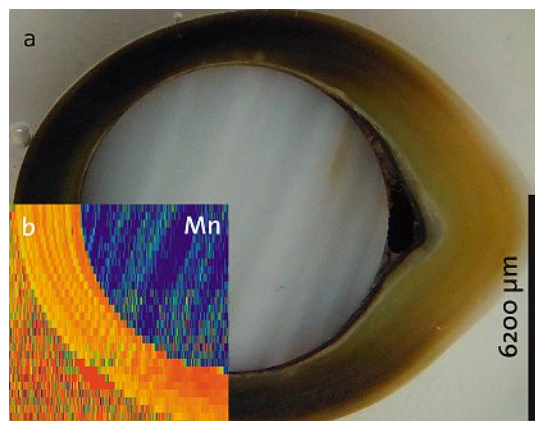
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Box plots (showing medians and interquartile ranges) of the Mn concentration categorized by region of origin and water condition. Higher levels are seen for fresh water pearls. A similar trend is seen for Ba and P, an inverse trend for Na, K, Mg, B, S, and Sr.



Photograph of the pearl section (a) with the Mn distribution represented with false colors (b). Several layers in the nacre and the inner bead are clearly visible.

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