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Techirghiol sapropelic mud under atmospheric exposure

Physicochemical Stability of Freshly Extracted Techirghiol Sapropelic Mud During Atmospheric Exposure

Implications for Lakeside Balneotherapy

Presented on behalf of the authors • Traian Virgiliu Surdu

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Why atmospheric exposure matters

THE PRACTICAL SETTING

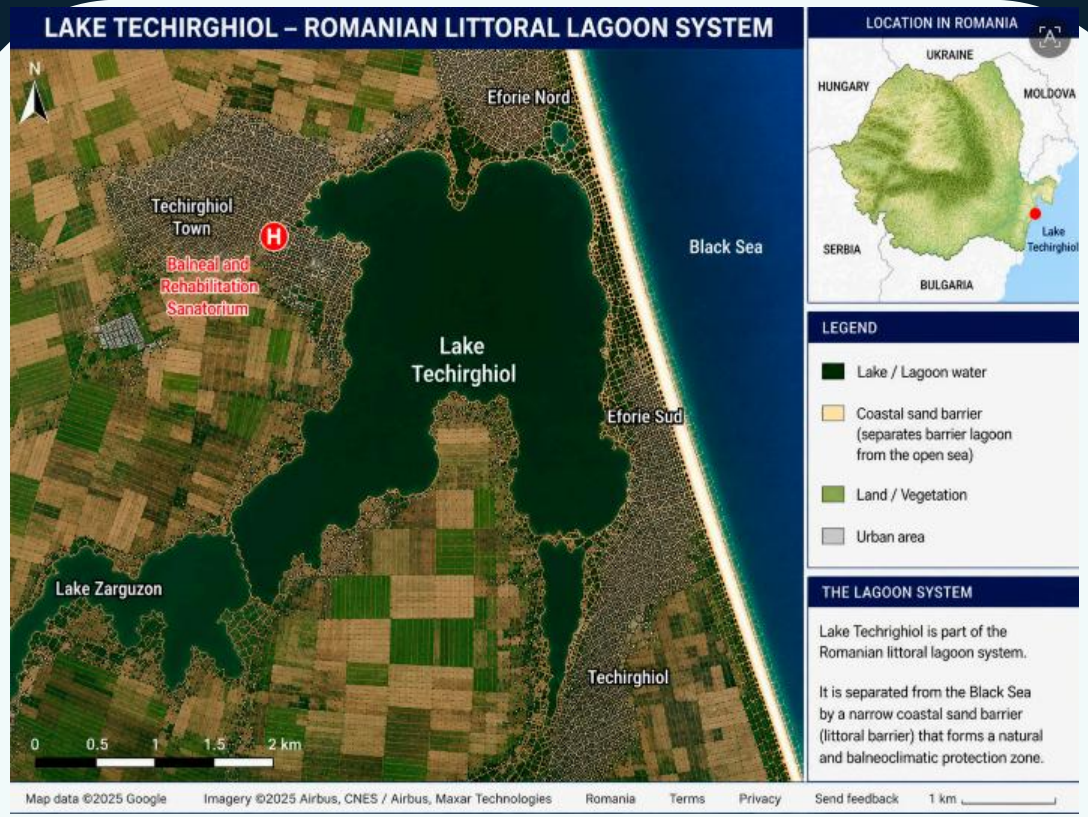
At Lake Techirghiol, naturally matured sapropelic mud is mixed with native lake water to make it easier to handle and apply. During lakeside use, it comes into contact with ambient air and progressively loses moisture.

THE SCIENTIFIC QUESTION

The initial chemical profile is well documented, but freshly prepared mud may change after extraction. Measuring only the wet material can also make some fractions appear unchanged as water evaporates.

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Techirghiol: natural mud, not artificial maturation



Location of Techirghiol Lake on the Romanian Black Sea coast (adapted from the published study).

MATERIAL CHARACTERISTICS

The hypersaline lake contains a naturally matured, mineral–organic sapropelic sediment. The experiment used this sediment and native lake water only, without an additional artificial maturation stage. The study therefore examines post-extraction changes rather than peloid formation.

Aim and interpretation framework

PRIMARY OBJECTIVE

To describe the evolution of prepared Techirghiol mud during 144 hours of atmospheric exposure, with measurements at baseline and every 24 hours.

TWO COMPLEMENTARY REPORTING BASES

Wet-mass concentrations describe the composition of mud at its current hydration state. Calculated dry-mass concentrations account for the changing proportion of water. Comparing both helps distinguish apparent concentration effects from other compositional patterns.

Experimental design and analytical approach

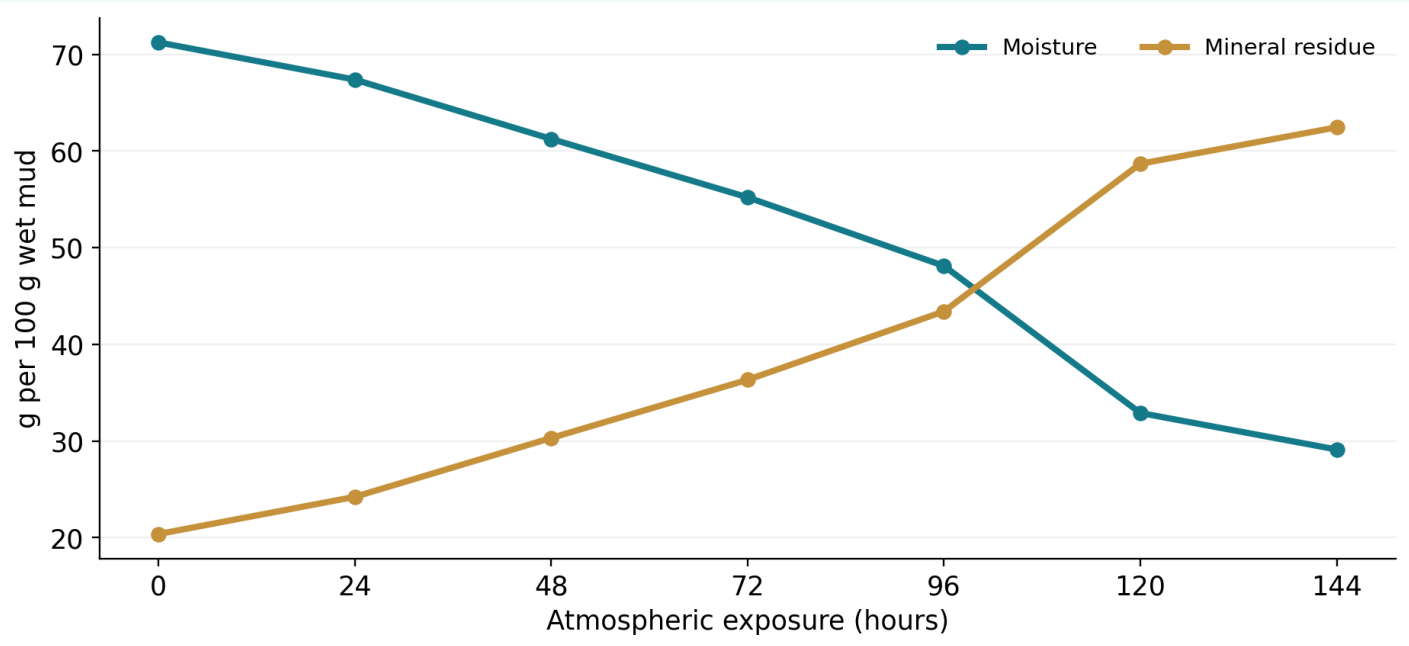
SAMPLE PREPARATION

One prepared batch contained approximately two parts naturally matured sapropelic mud and one part native lake water. It was divided into six uncovered glass Petri dishes (90 mm diameter; approximately 1–1.5 cm mud depth).

EXPOSURE AND MEASUREMENTS

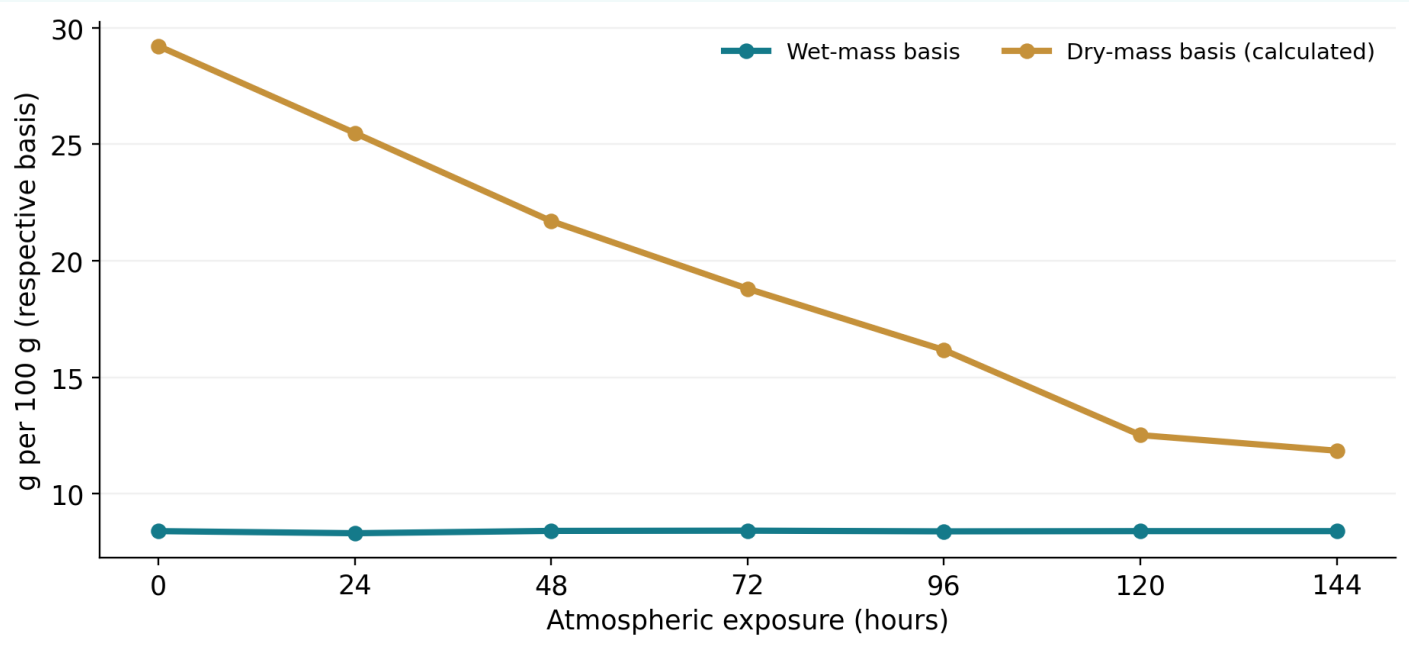
Each dish was assigned to one sampling time between 24 and 144 hours and kept at approximately 20 °C. Each dish was homogenized before testing, including any surface crust, then discarded. Global composition, organic and sulfide fractions were assessed through 144 hours; individual minerals through 72 hours.

Moisture loss changes the composition of wet mud



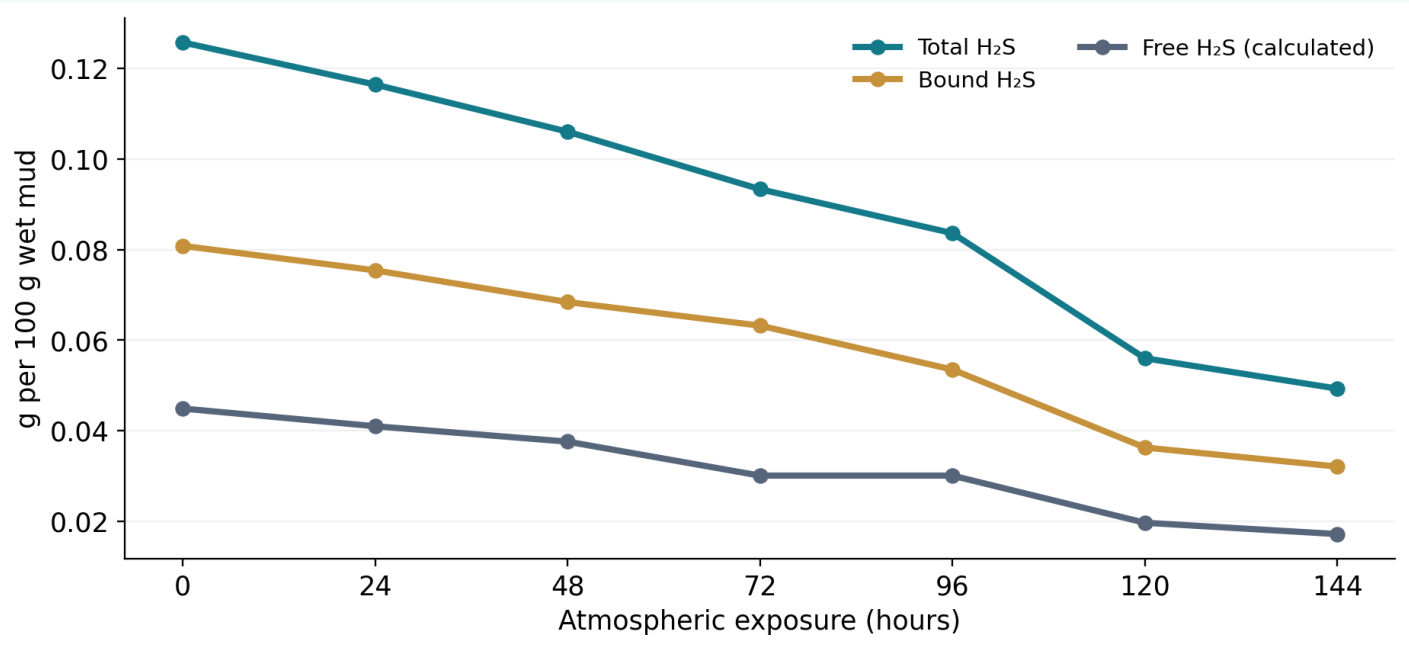
Moisture declined from 71.24% at baseline to 29.11% at 144 hours—a decrease of 42.13 percentage points. Meanwhile, the mineral residue expressed per 100 g of wet mud rose from 20.36% to 62.45%. Much of this apparent enrichment reflects progressive water loss rather than new mineral formation.

The wet-mass versus dry-mass distinction



The fraction volatile on calcination stayed close to 8.4 g/100 g wet mud throughout exposure. After normalization, however, it fell from 29.21 to 11.85 g/100 g dry mud (−59.4%). Thus, an almost flat wet-mass profile can conceal a substantial change relative to dry matter.

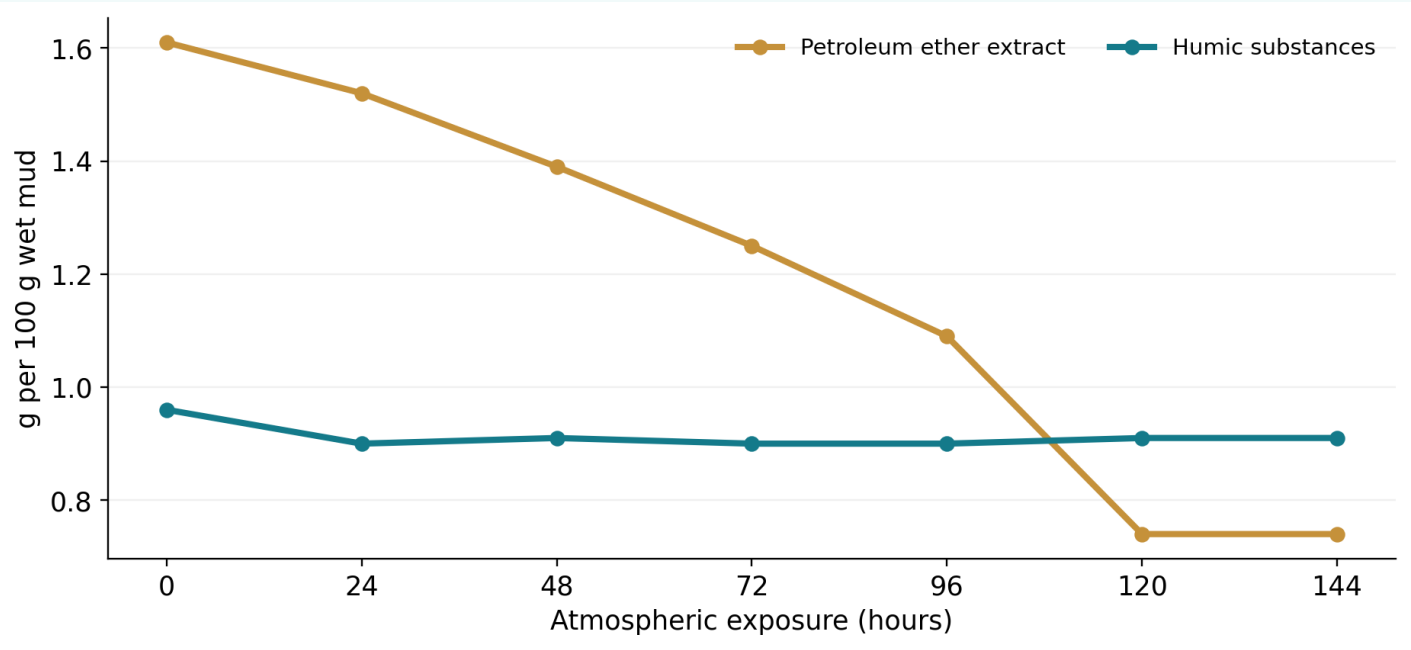
Sulfide fractions decrease progressively



Total sulfide, reported analytically as H_2S, declined from 0.1257 to 0.0493 g/100 g wet mud (−60.8%). The calculated dry-mass concentration declined by 84.1%. Free H_2S was calculated as total minus bound H_2S; these measurements do not quantify actual release or skin delivery.

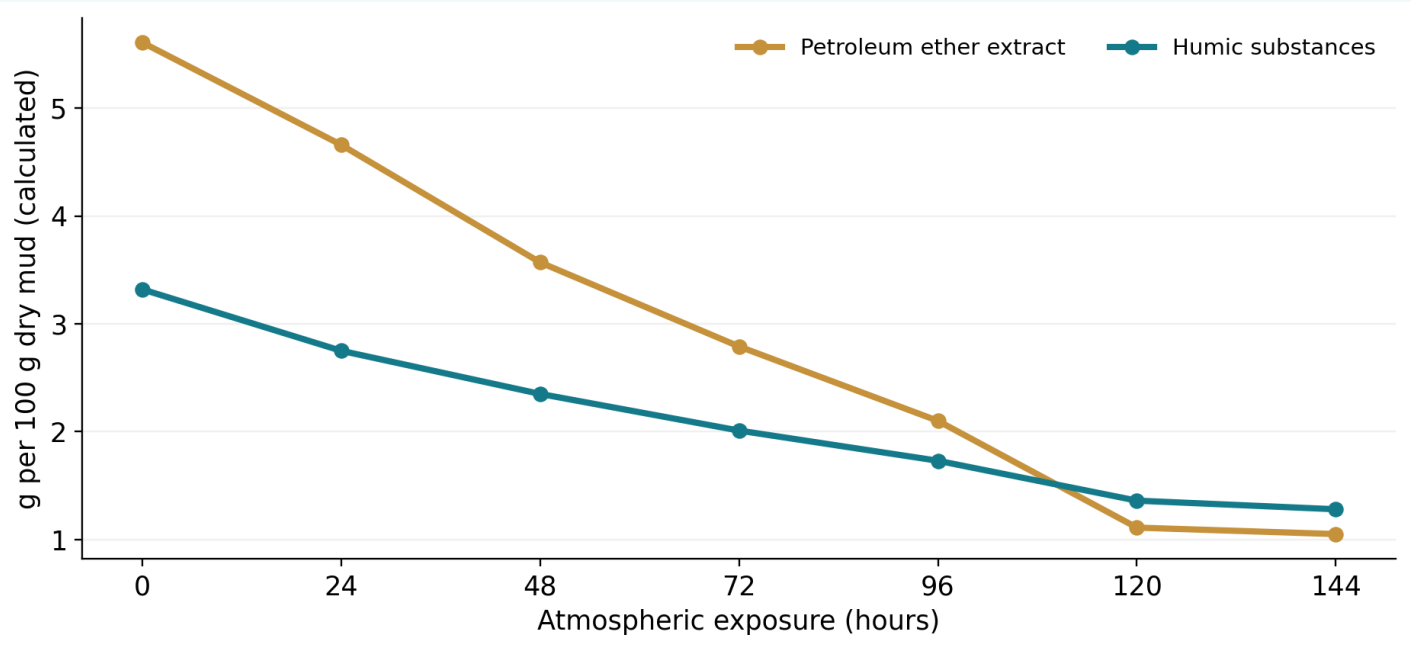
MAIN NUMERICAL FINDING

Organic components do not follow one pattern



The petroleum ether-extractable fraction fell from 1.61 to 0.74 g/100 g wet mud (−54.0%). By contrast, cellulose and the benzene–alcohol extract increased on a wet-mass basis. Humic substances, proteins and the aqueous extract showed only modest numerical variation in their wet-mass concentrations.

Dry-mass normalization clarifies organic trends



On a calculated dry-mass basis, the petroleum ether extract decreased by 81.3%, and humic substances by 61.5%. Cellulose and the benzene–alcohol extract remained relatively close to baseline. Their rises on the wet-mass scale are therefore largely consistent with concentration during dehydration, not demonstrated production.

Mineral constituents and carbon–nitrogen profile

INDIVIDUAL MINERALS: FIRST 72 HOURS

Iron, calcium, sodium, potassium, manganese, magnesium and acid-insoluble residue showed only small numerical differences when reported per 100 g dry mud. These findings should not be described as proof of chemical stability because measurements were single determinations and stopped at 72 hours.

ORGANIC CARBON, NITROGEN AND C/N

The C/N ratio remained close to 10 (10.18 initially; 10.00 at 144 h). Organic carbon and nitrogen showed comparatively small wet-mass variations but considerable calculated dry-mass decreases. The study could not separate genuine compositional changes from sample heterogeneity or analytical variability.

Visible changes accompany laboratory dehydration

APPEARANCE AFTER PROLONGED EXPOSURE

By the end of the observation period, the mud showed a visible surface crust, cracking, grayish discoloration and reduced homogeneity. These macroscopic findings accompanied the strong reduction in moisture content.

WHY THIS IS RELEVANT

Changes in consistency and hydration can influence how a natural therapeutic material is prepared, sampled and handled. However, the laboratory experiment did not measure spreadability, skin contact, patient outcomes or treatment effectiveness. The visible changes must therefore be interpreted descriptively.

Implications for lakeside balneotherapy

FOR CHARACTERIZATION AND HANDLING

Exposure duration and hydration status should be recorded when characterizing freshly prepared mud. Sample comparisons should use a clearly defined mass basis, especially when moisture varies substantially between measurements.

FOR RESEARCH AND CLINICAL INTERPRETATION

The observed decline in measured sulfide fractions is chemically relevant, but bulk composition alone does not establish bioavailability or therapeutic effect. This experiment also does not define a maximum safe or effective exposure duration for lakeside mud application.

Limitations and priorities for future studies

DESIGN LIMITATIONS

This was one exploratory experimental series, with one analytical value per parameter and sampling time and no replicates for statistical analysis. Ambient relative humidity and temperature ranges were not continuously recorded; mud mass per dish was not documented.

WHAT SHOULD BE STUDIED NEXT

Replicated experiments should control exposure conditions and layer thickness, quantify mass change, and examine the relationship between compositional evolution and relevant functional properties. Clinical effects require separate, appropriately designed studies rather than inference from chemistry alone.

Conclusions: what this study demonstrates

1. Air exposure caused pronounced dehydration and visible physical alteration of freshly prepared Techirghiol sapropelic mud.

2. Sulfide and several organic fractions declined, while the apparent trends depended strongly on wet- or dry-mass reporting.

3. Hydration state and exposure history are essential contextual variables for physicochemical characterization and handling.

4. No claim about therapeutic efficacy or a maximum permissible exposure time can be made from these data.

Thank you • Traian Virgiliu Surdu • FEMTEC 2026

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