Surface Sealing Characteristics Shape Soil Properties in Urban and Peri-Urban Areas: Case Evidence from the REUSES Project

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Introduction & Aim

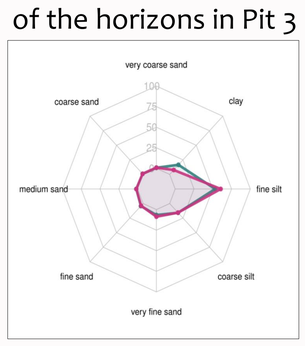
Soil sealing compromises essential soil ecosystem services, highlighting the urgent need for the implementation of sustainable land management policies. **De-sealing practices** have gained significant traction in recent years, although preliminary studies are mandatory to evaluate the **soil conditions** beneath and **guide** the planning of necessary interventions.

Within this context, the REUSES project (**Restore Urban Sealed Soil for Alternative Ecosystem Services**) aims to convert abandoned sealed soils into community gardens. This study investigated how the characteristics and uniformity of **surface sealing materials** influence the **pedological properties** of soils within the REUSES project.

Soil Properties

Site 1

Particle-size distribution of the horizons in Pit 3



Gleyic Ekranic Technosol

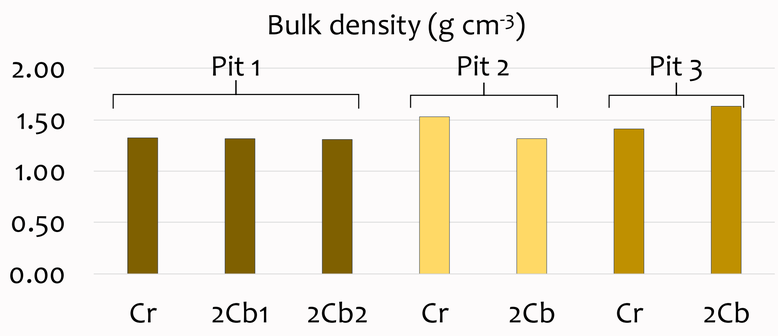
BT : continuous asphalt cover.

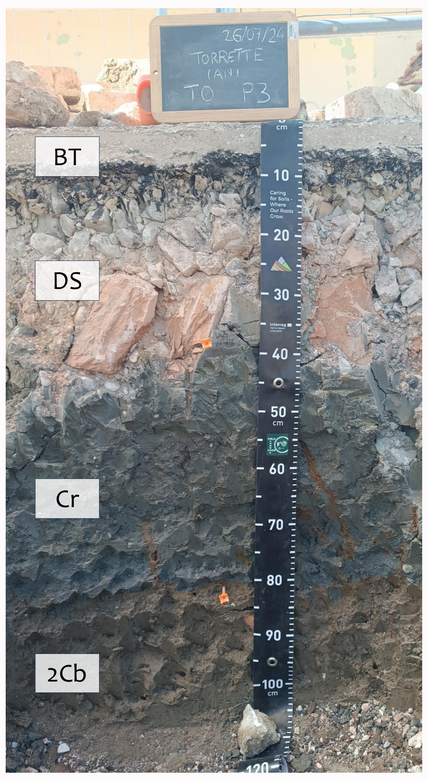
DS: crushed stones.

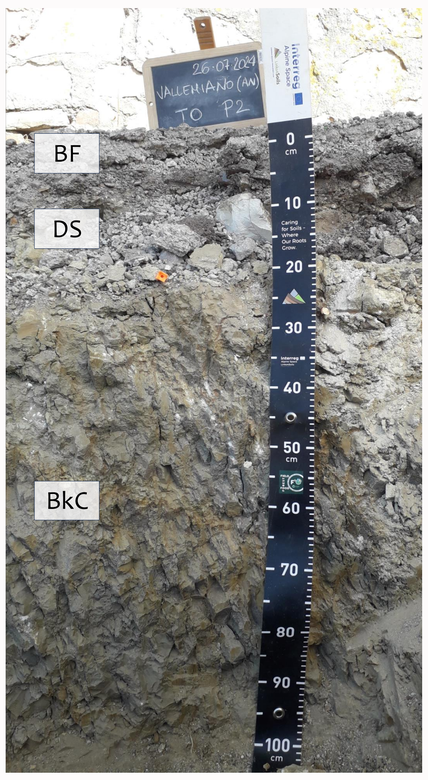
Cr: abundant redoximorfic features.

2Cb: buried horizon with massive structure.

Bulk density (g cm^{-3})







Site 2

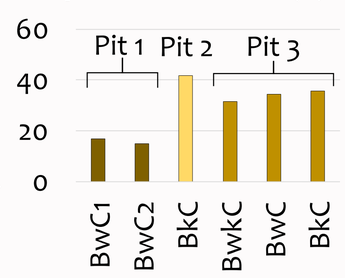
Ekranic Technosol

BF : degraded and heterogeneous asphalt cover.

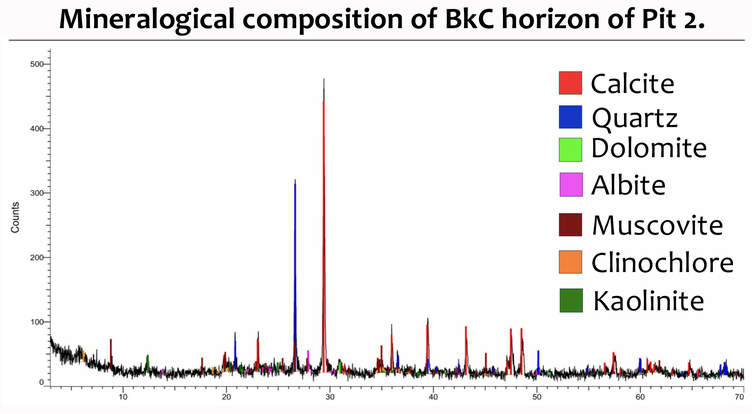
DS: crushed stones.

BkC: few carbonate concretions.

Calcium carbonate equivalent content (%)

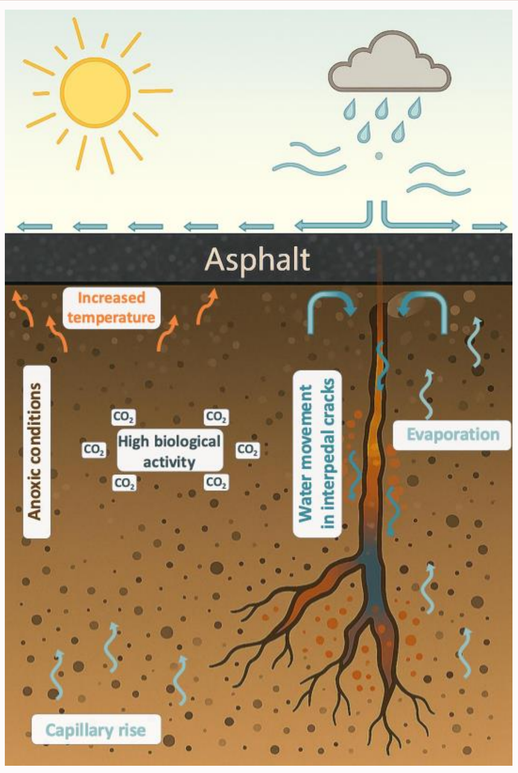


Mineralogical composition of BkC horizon of Pit 2.



Soil Processes

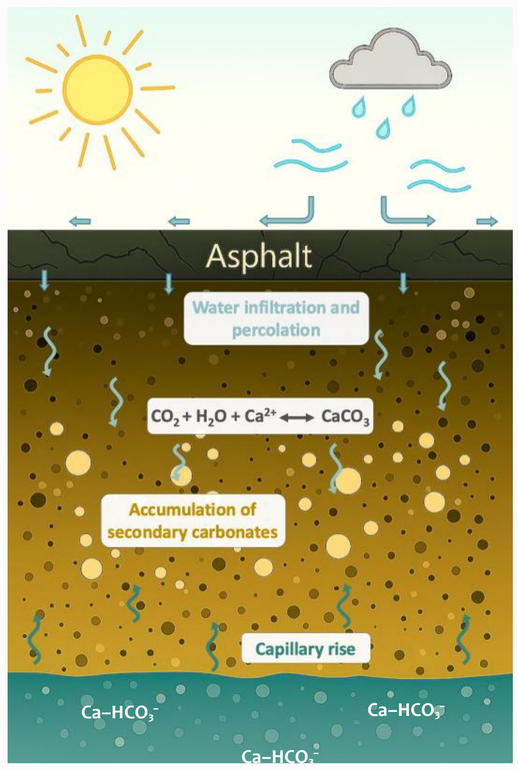
Site 1



Asphalt cover, due to its low albedo, **increased** soil surface **temperatures** and reduced thermal fluctuations. This promoted biological activity and oxygen consumption, which gradually led to CO_2 accumulation and **anoxic conditions**. The impermeable layer also disrupted **water infiltration** and **gas exchange**, causing moisture to condense and accumulate in soil. Condensed water primarily moved downward through interpedal cracks, where **redoximorphic features** developed due to prolonged air retention.

Site 2

Limited **water infiltration** due to the degraded soil cover dissolved carbonates and transported them downward, where **secondary forms** re-precipitated as soil moisture decreased or the solution became supersaturated. This pedogenic process has also been attributed to chemical reactions between **dissolved CO_2 and soil cations**, leading to the formation of carbonate minerals such as calcite. Additionally, carbonates likely formed as a result of the **capillary rise** of groundwater rich in calcium and bicarbonate ions.



Conclusion

A comprehensive evaluation of **soil heterogeneity in urban contexts** is imperative for the formulation of effective, **site-specific** interventions aimed at restoring the ecosystem services of de-sealed soils. Such an approach enhances the efficacy of environmental rehabilitation strategies by facilitating the recovery of soil functions and contributing to the **long-term sustainability** of urban ecosystems. Future research should focus on evaluating the long-term effects of de-sealing and the potential for soil rehabilitation under different urban planning scenarios.

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