Plasticrusts and pyroplastic: two novel plastic debris types detected in Giglio island, Italy

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INTRODUCTION:

Plasticrusts and pyroplastic are novel plastic debris types that have only recently been reported for the first time from Madeira island (Atlantic Ocean, Gestoso et al. 2019) and the southern United Kingdom, respectively (Turner et al. 2019). While plasticrusts result from plastic debris being wave-swept across rugose rocks, pyroplastics derive from burnt plastic waste. During field surveys in Giglio island (Tyrrhenian Sea, Italy), we detected plasticrusts on a wave-exposed rocky shore and pyroplastic on a wave-sheltered sandy beach (Ehlers & Ellrich 2020, Fig. 1).

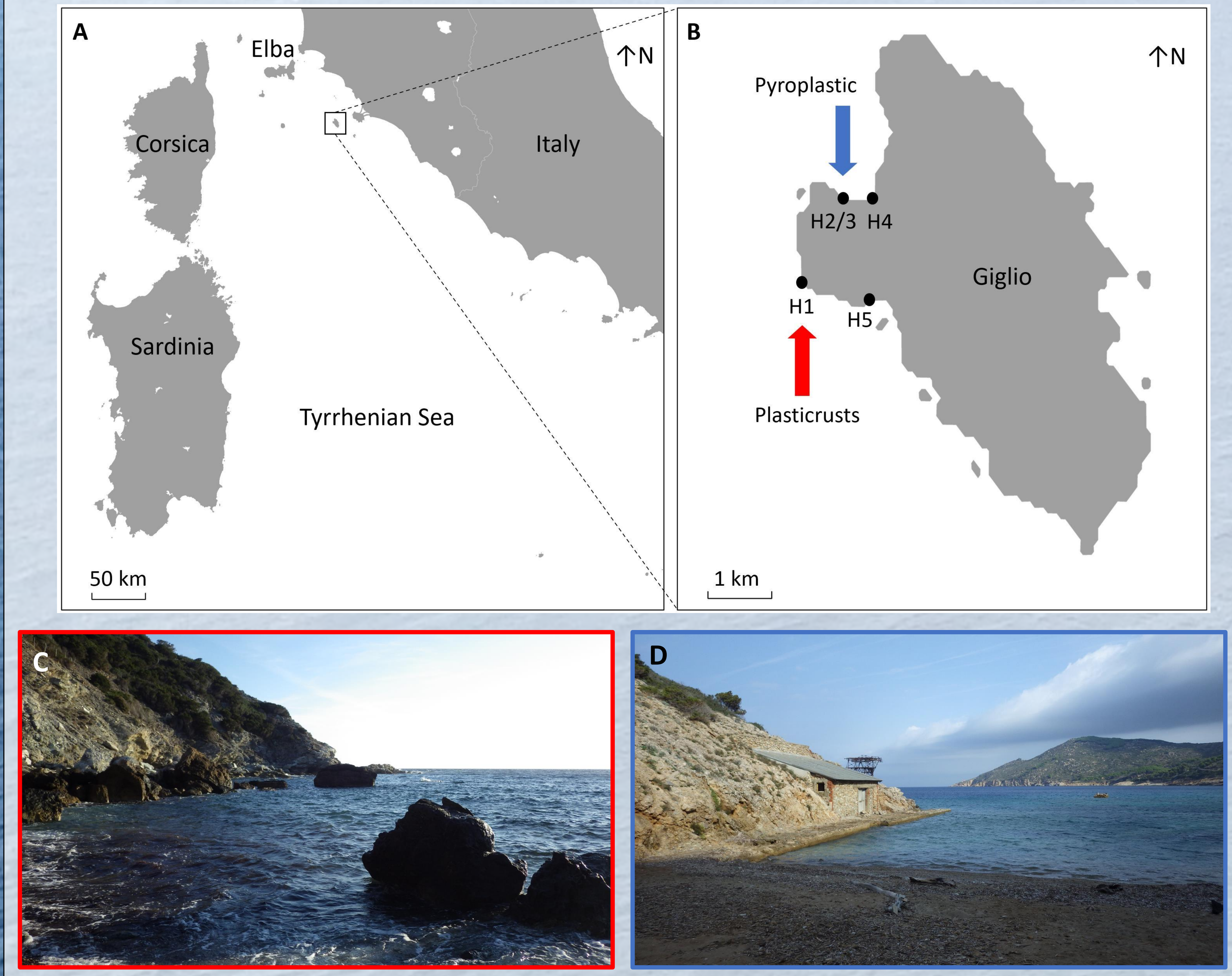

Fig. 1 A) Location of Giglio island in the Tyrrhenian Sea. **B)** Locations of the five surveyed habitats (H1-H5) in Giglio. H2 and H3 were adjacent habitats and, thus, depicted by a single dot. **C)** The wave-exposed rocky shore (H1). **D)** The wave-sheltered beach (H2).

METHODS:

In the field, we measured plasticrust density, area and percent cover using quadrats (10 cm x 10 cm). At the lab, we determined plasticrust thickness using a digital microscope and pyroplastic size using digital calipers. Furthermore, we identified the plasticrust and pyroplastic materials (i.e., polymer types) with Fourier-transform infrared spectroscopy (FTIR, Fig. 2). We conducted our FTIR measurements in attenuated total reflectance (ATR) mode in a wavenumber range between 4000 and 370 cm^{-1} with 8 co-added scans and a spectral resolution of 4 cm^{-1}. Then, we compared the obtained spectra with the Bruker spectral library in Opus 7.5 software.

Fig. 2 Sonja M. Ehlers identifying polymer types using FTIR (Vertex 70, Bruker, Ettlingen, Germany) at the Federal Institute of Hydrology in Koblenz, Germany.

RESULTS:

Plasticrust (Fig. 3A) density was 3.25 ± 1.65 plasticrusts/dm^2 (mean ± SE; n= 4 quadrats). Plasticrust area was 0.46 ± 0.08 mm^2 (n= 13 plasticrusts). Plasticrust cover was 0.02 ± 0.01 % (n= 4 quadrats). Plasticrust thickness ranged between 0.5 and 0.7 mm. FTIR analyses revealed the plasticrust material as polyethylene (PE, Fig. 3B). We did not detect any plasticrusts on the wave-sheltered rocky shores (H3-H5, Fig. 1B).

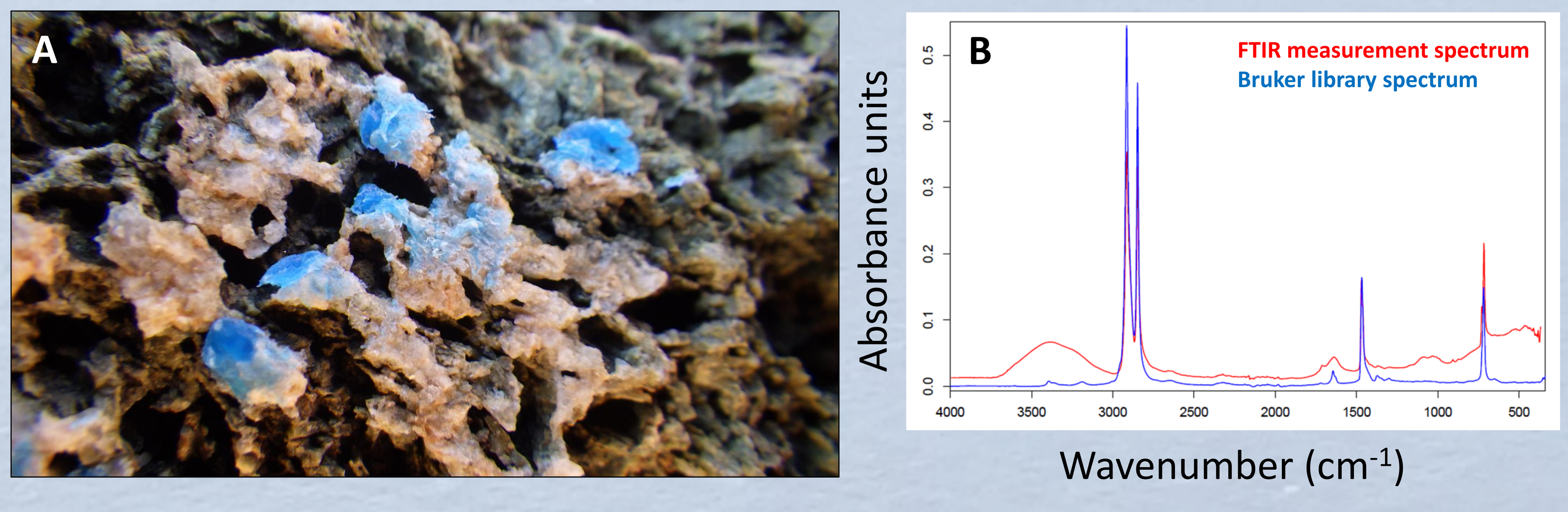

Fig. 3 A) The detected blue plasticrusts consisted of **(B)** PE material.

The **pyroplastic** had a stone-like appearance (Fig. 4A) with blue inclusions (Fig. 4B). Pyroplastic size was approximately 2 cm × 1.4 cm × 0.5 cm (length x width x height). FTIR analyses showed that the pyroplastic material was polyethylene terephthalate (PET, Fig. 4C). On the beach, we detected burnt charcoal near the pyroplastic. Finally, we found several PET beverage bottles (Fig. 4D, E) in each habitat (H1-H5, Fig. 1B).

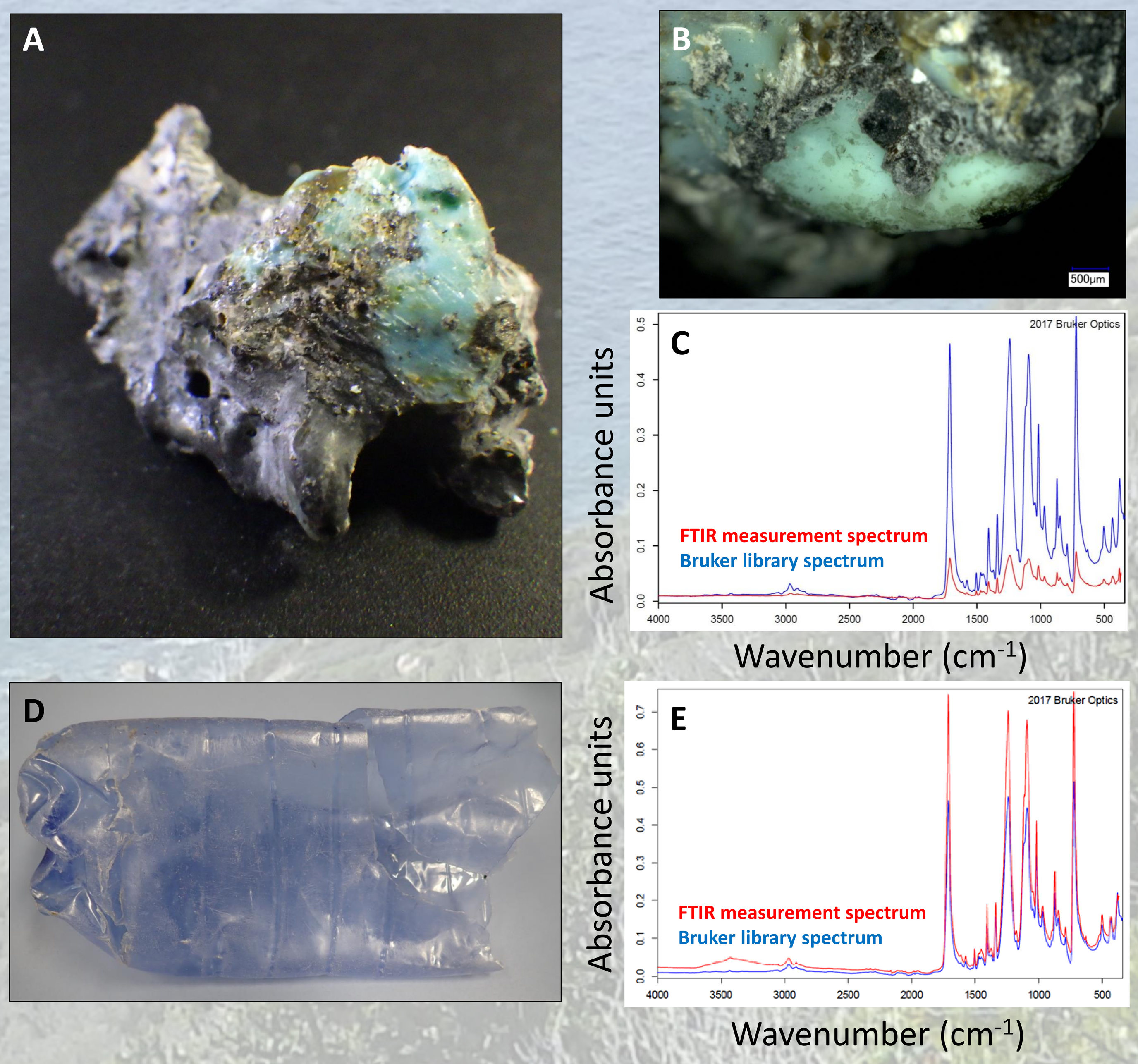

Fig. 4 A) The detected pyroplastic with blue inclusions. **B)** Pyroplastic close-up. **C)** The FTIR spectrum that revealed PET as the pyroplastic material. **D)** PET bottle found on the beach (H2, Fig. 1B). **E)** The FTIR spectrum that confirmed PET as the bottle material.

DISCUSSION:

Our results from Giglio resemble findings from Madeira and the United Kingdom indicating that plasticrusts and pyroplastics are not local phenomena. Plasticrusts are generated by sea waves washing plastic debris across rugose rock (Gestoso et al. 2019) which suggests that wave exposure may influence plasticrust generation. This notion is supported by the fact that we detected the plasticrusts on a wave-exposed rocky shore (H1) but did not detect any plasticrusts on wave-sheltered rocky shores (H3-H5, Fig. 1). Since the plasticrusts were roughly within the microplastic (MP) size range (i.e., particles < 5 mm) and as invertebrates, such as grazing snails, readily consume MPs (Ehlers et al. 2020), it would be interesting to investigate wether invertebrates ingest MPs off the plasticrusts to examine this potential MP pathway into the foodweb. Finally, our findings of PET pyroplastic, PET beverage bottles and burnt charcoal on the beach (H2, Fig. 1) suggest that the pyroplastic resulted from a campfire or waste incineration fire. Since plasticrusts and pyroplastic might harm organisms through MP ingestion and toxic substance release, respectively (Gestoso et al. 2019, Turner er al. 2019), we recommend that future studies should monitor the distribution and abundance of these novel plastic debris types and examine the ecotoxicity of these potentially hazardous materials.

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