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# Characterization of a hot "fumarolic mofette" at Caldeiras da Ribeira Grande/S. Miguel, Acores

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A 10 x 10m subarea of a hot and heavily $CO_2$ emitting mofette on a hilly grassland at Caldeiras da Ribeira Grande, located on the north flank of Fogo Volcano, was studied. A 1 x 1m grid was laid on top of the area and at each intersection, soil gas measurements were performed at three different depths. $CO_2$, CO and $O_2$ were measured. In addition, soil $CO_2$ flux using the accumulation chamber method was measured and soil cores were taken at each grid intersection at a depth of 7-13cm as this depth was thought to reflect the main rooting horizon of grasses and herbaceous plants in that area. Soil water content, soil pH, conductivity and organic matter were determined. Quantitative vegetation analysis was carried out and total number of plant species as well as species total and individual coverage were estimated in each square.

Carbon dioxide was emitted in 4/5 of the total area and only $20m_2$ showed no or a low $CO_2$ emission. Only the upper horizontal part of the mofette showed $CO_2$ background values in the upper soil horizon. The lower part of the area was strongly $CO_2$ emitting, with $CO_2$ concentrations reaching 90-100% at the left lower part of the area. Oxygen values inversely corresponded to the $CO_2$ concentrations. Overall, $CO_2$ values increased with depth, whereas $O_2$ decreased. Soil $CO_2$ fluxes mirrored the $CO_2$ concentrations to a large extent.

In addition, soil temperature mirrored $CO_2$ concentrations. Temperatures were close to ambient in the upper one-third of the area where $CO_2$ was low; temperature increased even in the upper soil horizon in the lower 2/3 of the area, where $CO_2$ emission was high. Also, temperature increased with soil depth but was 70℃ even at only 20cm soil depth. Two dominant high temperature spots were found at the lower part of the mofette; a lower temperature "channel" divided the spots.

Total plant coverage showed a "Y" shape in the lower 5m of the area. Plant coverage was close to 100% all over the area except at those parts where soil temperature, soil CO and soil $CO_2$ concentrations were high (40-70℃). Interestingly, plant species number was lowest on low $CO_2$ emitting soils; between one and four species grew at these sites (2-12% $CO_2$). On higher emitting and warmer soils, species number slightly increased. Up to 13 different species were counted.

Two grasses, namely Lolium perenne (perennial ryegrass) and Holcus lanatus (meadow soft grass) grew only on cooler, low-$CO_2$-emitting sites; they thus reflect thermophobic and mofettophobic plant species (Pfanz et al. 2004, 2019). Cyperus esculentus (earth almond), Kyllingia brevifolia (shortleaf spike sedge), and Oxalis corniculata (creeping wood sorrel) proved to be highly thermophilic . These species also proved to be mofettophilic as they also tolerate quite high $CO_2$ concentrations in their rooting horizon.

As in other places with $CO_2$ emissions at ambient temperatures, also in hot and $CO_2$ emitting sites, plants can be found that indicate high $CO_2$ emission (mofettophiles) or high temperatures (thermophiles). In our case also thermo-mofettophiles were found.

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