Is the polarity-sensitive magnetic sense in *Cataglyphis nodus* ants based on particles in the antenna?

Dhanashree K. Alshi[1], Dr. Franziska Curdt[1], Dr. Laura Ziegenbalg[1], Prof. Dr. Michael Winklhofer[1,2], Dr. Pauline N. Fleischmann[1,2]

1 Institute for Biology and Environmental Sciences (IBU), University of Oldenburg
2 Forschungszentrum Neurosensorik

Abstract

The Earth's magnetic field serves as a crucial navigational cue for numerous animal species, yet the most enigmatic question is how these underlying sensory mechanisms function in the field of sensory biology. Desert ants of the genus *Cataglyphis* have recently emerged as suitable experimental model organisms for magnetoreception research due to their remarkable navigational abilities and newly discovered polarity-sensitive magnetic compass—a unique trait that distinguishes them from most other species studied to date. Unlike birds and monarch butterflies that appear to use inclination-based magnetic orientation, *Cataglyphis* ants demonstrate the ability to detect magnetic polarity, suggesting they employ a fundamentally different magnetoreceptive mechanism, likely based on magnetic particles rather than light-dependent radical-pair chemistry. Furthermore, recent evidence indicates that magnetic information is integrated into ant's internal compass system (central complex) and memory centers (mushroom bodies), suggesting a sophisticated neural architecture for magnetic navigation.

Here, we present a project that takes a multidisciplinary approach to investigate the sensory basis of magnetoreception. We will focus on examining candidate magneto-receptive structures, particularly the Johnston's organ in the pedicel of the ant antenna. The examination will be approached by using different techniques like electron microscopy with energy-dispersive X-Ray spectroscopy (EDX) and electron paramagnetic resonance (EPR).

This project is supported by the German Research Foundation, specifically by the SFB 1372 "Magnetoreception and Navigation in Vertebrates" (project number: 395940726, sub-project Sig02 awarded to M.W.), and by an individual research grant (project number: 422729997 awarded to P.N.F.).