ZEBRAFISH MAGNETITE AND LONG-LIVED ROHON-BEARD NEURONS: EXPANDING OUR VIEW OF TWO ZEBRAFISH SENSORY SYSTEMS IN DEVELOPMENT AND ADULTHOOD

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DEDICATION

This dissertation is dedicated to my cute Caltech baby, Kizashi James. Please learn to love God and to seek knowledge in your youth; dream well all your life; work hard so that you may achieve and provide; and never, ever, compromise your integrity.

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ABSTRACT

During embryogenesis, the central nervous system (CNS) transforms from what seems like an amorphous mass of cells to a rod-like structure, and then to a fully functional and complex system of tissues composed of multiple cell types. Using confocal laser scanning microscopy (CLSM), I demonstrate a modified version of *in toto* imaging to track normal spinal cord organization in zebrafish from bud stage, ~ 11 hours post-fertilization (hpf), to 48 hpf. I also assisted in identifying several transgenic lines using a gene trap vector, the FlipTrap (FT), which creates a normally localized and functional fluorescent fusion protein for *in vivo* analysis of gene expression throughout development. I used two FT lines along with a modified version of *in toto* imaging to study sensory cells in the dorsal spinal cord.

With the FT tool, I discovered a subset of Rohon-Beard (RB) neurons that perdures into the adult. These uniquely transient chemo- and mechano-sensory cells have been well characterized in the dorsal spinal cord of lower vertebrates; however, the notion of persistent RBs contrasts with dogma suggesting that the entire population disappears during the early larval period. The coexistence of RB-like neurons with dorsal root ganglia (DRG) suggests that zebrafish have two post-embryonic sensory systems, challenging the previous notion that only peripheral sensory neurons survive.

In the second part of my dissertation I describe my studies of biogenic magnetite which has been detected in a broad range of organisms, including magnetotactic bacteria, migratory fish and birds, invertebrates, and humans. Magnetite mediates magnetosensation in many species through the effects of pulse-remagnetization on behavior. The mechanisms of magnetite biomineralization are not well characterized in higher organisms. Previous studies have shown deposits of magnetite in projections of the trigeminal nerve, alongside behavioral evidence suggesting that both optical pumping and magnetite-based mechanisms may operate simultaneously. Subsequent efforts to identify the anatomical seat of magnetoreceptors have focused on the same locations in new organisms, excluding other areas. Here I report the unexpected presence of biogenic magnetite in the lateral line region of the genetically and physiologically tractable vertebrate model organism, *Danio rerio*.

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