

# Origin and evolution of a unique hemoglobin gene from a hydrothermal vent scale-worm (*Branchipolynoe*)



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Hydrothermal vent endemic species of scaleworms (Annelida; Polynoidae) possess hemoglobin (Hb), while their shallow-water relatives only possess tissue. In addition, *Branchipolynoe* possesses a multi-domain extracellular Hb, a unique feature for annelids. Our goal was to understand the origin and evolution of this Hb, which recently evolved in a limited group of annelids, specifically in the *Branchipolynoe* branch.

The 4-domain structure showed a different evolutionary history when compared to other extracellular annelid globins. This multi-domain globin is the result of tandem duplications of the single-domain whole coding sequence.

A search for positively selected amino acid positions during the evolution of the 4-domain structure revealed several positions in the branch that are likely to be important for the multi-domain function. Some of them are located in the heme pocket, and others are exposed on the surface of the globin, possibly in a zone of interactions between domains.

A 3D model of the *Branchipolynoe* globins was built in order to better understand the locations of these key residues and those identified as being under positive selection.

Given the extreme conditions under which these scaleworms live, with low levels of oxygen, these globins most likely play an important role in their respiratory adaptation.

