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PRC1 nano-structures compact Hox chromatin during Drosophila embryogenesis

Polycomb machinery is required to maintain silencing of key developmental genes during development. In Drosophila, its genomic landscape is composed of discrete element named PREs, where Polycomb group (PcG) proteins bind, and large domains covered with H3K27me3 marks. Inside the cell nucleus, Polycomb foci are the place where PcG subunits and its associated chromatin localize. To connect the linear localization of PcG proteins on chromatin and its 3D organization in cell nuclei, we observed Drosophila embryos in STED microscopy. Super-resolution microscopy reveals that Polycomb foci associated to Hox clusters are composed of several highly mobile PRC1 substructures. STED microscopy shows that PREs are more associated with these nano-globules than H3K27me3 chromatin not covered by PcG proteins. Enrichment of Polycomb associated chromatin at the periphery of PRC1 substructures suggests that the interface between repressed Hox chromatin and PRC1 nano-globules is critical for their formation. Based on the genomic location of PRC1 subunits and the positions of PRC1 nano-globules inside large Polycomb foci, polymer simulations can reproduce the Ph-dependent compaction of BX-C. This work demonstrates that PRC1 subunits form nano-globules organizing Polycomb associated chromatin during Drosophila embryogenesis. By connecting linear chromatin profiles and its 3D folding inside cell nuclei, these PRC1 higher-order structures might be key elements of canonical Polycomb machinery.

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