MAR15-2015-021026

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Surface cell expansion drives radial cell intercalations in zebrafish gastrulation

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Radial cell intercalations are commonly associated with tissue spreading in many developmental and disease-related processes. Yet, how radial cell intercalations are controlled and function in tissue spreading remains unknown. Here, we use a combination of experiments and theory to analyze radial cell intercalations during doming, the initial spreading of the blastoderm over the yolk cell at early zebrafish gastrulation. Strikingly, we found that radial cell intercalations do not drive doming, but rather determine the viscous relaxation behavior of the blastoderm in response to tissue surface tension (TST)-driven deformation. We further show that radial cell intercalations and, consequently, doming are triggered by surface epithelial cells expanding their surface area and thus reducing TST. Thus, radial cell intercalations are required for translating changes in tissue-scale forces into tissue deformation.