CELL POLARITY

Sticky poles

> “…PopZ … anchors chromosome origins at bacterial cell poles.”

During bacterial cell division, replicated chromosome origins are targeted to opposite cell poles. This is required for accurate chromosome segregation and cell division. But how chromosome origins are localized to and retained at cell poles is poorly understood. The groups of Shapiro and Jacobs-Wagner have now identified PopZ, a multimeric protein in *Caulobacter crescentus* that anchors chromosome origins at bacterial cell poles.

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Both groups identified the *popZ* gene in a screen for polarity factors, and showed that cells that lack or overexpress PopZ have a cell division defect. Fluorescently tagged PopZ localizes to the existing ‘old’ cell pole and later also accumulates at the newly formed pole following replication initiation. The bipolar localization exists until the cell divides and yields daughter cells with PopZ at the old cell pole. This localization pattern resembles that of chromosome origins in complex with the DNA-partitioning protein ParB, which suggests that the origin–ParB complex might be anchored to the cell pole through PopZ.

Indeed, a *popZ*-deletion strain lacked ParB foci at the cell poles and showed dynamic movement of ParB foci in the cells. Time-lapse microscopy studies by Jacobs-Wagner and colleagues indicated that the induction of PopZ expression led to the gradual polar localization of PopZ; this was followed by continuous movement of ParB until it was eventually retained at the cell poles. These observations imply that polar anchoring occurs by a diffusion–capture mechanism, which the Shapiro group showed for single molecules of PopZ using high-speed video microscopy. Both groups further demonstrated, by electron microscopy or cryo-electron microscopy, that PopZ self-associates into multimeric structures.

Using co-immunoprecipitation, the groups showed that PopZ interacts with the origin–ParB complex through ParB. The Shapiro team further demonstrated direct PopZ–ParB interaction by surface plasma resonance. Expression of PopZ in *Escherichia coli* led to its localization at the cell pole, and when ParB was coexpressed, it colocalized with PopZ. Taken together, these findings indicate that ParB is specifically recruited to the cell pole by interacting with PopZ.

So how does PopZ recognize a cell pole, even in a foreign system such as *E. coli*? The Jacobs-Wagner group established that, whereas membrane curvature is not a key factor in the clustering of PopZ at the cell poles, the absence of DNA in these cellular regions is. The localization of PopZ therefore seems to rely on a mechanism of self-organization into multimeric structures, which results in an adhesive complex that fixes the chromosome origin at the cell pole.

Finally, both groups noticed that PopZ also affects polar stalk morphogenesis. The Jacobs-Wagner team further showed that PopZ is required for the polar localization of CckA and DivJ, which have functions in cell-cycle regulation, and affects the asymmetric localization of the polarity factor TipN. So, although the underlying mechanisms of these additional roles are unknown, PopZ might have a broader role in the organization of the cell poles in *C. crescentus*.

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ORIGINAL RESEARCH PAPERS Bowman, G. R. *et al.* A polymeric protein anchors the chromosomal origin/ParB complex at a bacterial cell pole. *Cell* **134**, 945–955 (2008) | Ebersbach, G. *et al.* A self-associating protein critical for chromosome attachment, division, and polar organization in *Caulobacter*. *Cell* **134**, 956–968 (2008)