

**Data S1.**

Protein phosphorylation dataset of GV and MI oocytes. Two independent mass spectrometry analyses were performed. The first (400oo) used 400 GV oocytes and 400 MI oocytes, while the second (1500oo) used 1500 GV oocytes and 1500 MI oocytes.

**Data S2.**

MI-stage-specific phosphorylation sites of MARDO-localized proteins. Phosphorylation sites were filtered with the following criteria:  $MI_{intensity} / GV_{intensity} > 4$ ,  $PEP < 0.01$ , Phospho (STY) Probabilities  $> 0.9$ .

**Data S3.**

Differentially expressed genes (DEGs, adjusted p-value  $< 0.05$ , average log2 fold-change  $> 0.5$ ) in *Zar1*<sup>-/-</sup> oocytes versus *Zar1*<sup>+/+</sup> oocytes.

**Data S4.**

Prematurely lost maternal mRNAs in *Zar1*<sup>-/-</sup> oocytes that are normally translationally activated during oocyte meiotic maturation or MII-zygote transition.

**Data S5.**

Primers used for construct building.

**Data S6.**

Primers used for RT-qPCR.