



Title	Cfs1p, a Novel Membrane Protein in the PQ-Loop Family, Is Involved in Phospholipid Flippase Functions in Yeast
Author(s)	Yamamoto, Takaharu; Fujimura-Kamada, Konomi; Shioji, Eno et al.
Citation	G3 : genes, genomes, genetics, 7(1), 179-192 https://doi.org/10.1534/g3.116.035238
Issue Date	2017-01
Doc URL	https://hdl.handle.net/2115/64710
Rights(URL)	https://creativecommons.org/licenses/by/4.0/
Type	journal article
File Information	TableS1.pdf, Table S1



Table S1 Strain list

Strain	Genotype	Source or reference
YEF473	<i>MATa</i> α <i>his3</i> Δ -200/ <i>his3</i> Δ -200 <i>leu2</i> Δ -1/ <i>leu2</i> Δ -1 <i>lys2</i> -82/ <i>lys2</i> -82 <i>trp1</i> Δ -63/ <i>trp1</i> Δ -63 <i>ura3</i> -52/ <i>ura3</i> -52	Bi and Pringle 1996
YKT1066	<i>MATa</i> <i>his3</i> Δ -200 <i>leu2</i> Δ -1 <i>lys2</i> -82 <i>TRP1</i> <i>ura3</i> -52	Zendeh-boodi <i>et al.</i> 2013
YKT249	<i>MATa</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>trp1</i> Δ -63	Misu <i>et al.</i> 2003
YKT1507	<i>MATa</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>TRP1</i>	Takeda <i>et al.</i> 2014
YKT2024	<i>MATa</i> <i>ymr010w</i> :: <i>Tn3-lacZ-LEU2</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>trp1</i> Δ -63	This study
YKT2070	<i>MATa</i> <i>cfs1</i> Δ :: <i>KanMX4</i> <i>TRP1</i>	This study
YKT2025	<i>MATa</i> <i>cfs1</i> Δ :: <i>KanMX4</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>TRP1</i>	This study
YKT2035	<i>MATa</i> <i>kes1</i> Δ :: <i>KanMX4</i> <i>TRP1</i>	This study
YKT2026	<i>MATa</i> <i>kes1</i> Δ :: <i>KanMX4</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>TRP1</i>	This study
YKT2029	<i>MATa</i> <i>fun26</i> Δ :: <i>KanMX4</i> <i>TRP1</i>	This study
YKT2030	<i>MATa</i> <i>fun26</i> Δ :: <i>KanMX4</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>TRP1</i>	This study
YKT2031	<i>MATa</i> <i>plb3</i> Δ :: <i>KanMX4</i> <i>TRP1</i>	This study
YKT2032	<i>MATa</i> <i>plb3</i> Δ :: <i>KanMX4</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>TRP1</i>	This study
YKT1636	<i>MATa</i> <i>drs2</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2081	<i>MATa</i> <i>cfs1</i> Δ :: <i>KanMX4</i> <i>drs2</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2082	<i>MATa</i> <i>kes1</i> Δ :: <i>KanMX4</i> <i>drs2</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2039	<i>MATa</i> <i>rcy1</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2083	<i>MATa</i> <i>cfs1</i> Δ :: <i>KanMX4</i> <i>rcy1</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2084	<i>MATa</i> <i>kes1</i> Δ :: <i>KanMX4</i> <i>rcy1</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT1890	<i>MATa</i> <i>HIS3MX6</i> :: <i>P_{GALI}</i> -3HA-CDC50 <i>lem3</i> Δ :: <i>TRP1</i>	This study
YKT2045	<i>MATa</i> <i>HIS3MX6</i> :: <i>P_{GALI}</i> -3HA-CDC50 <i>lem3</i> Δ :: <i>TRP1</i> <i>cfs1</i> Δ :: <i>CaURA3</i>	This study
YKT1120	<i>MATa</i> <i>HIS3MX6</i> :: <i>P_{GALI}</i> -3HA-CDC50 <i>lem3</i> Δ :: <i>TRP1</i> <i>crf1</i> Δ :: <i>HphMX4</i>	Yamagami <i>et al.</i> 2015
YKT2046	<i>MATa</i> <i>HIS3MX6</i> :: <i>P_{GALI}</i> -3HA-CDC50 <i>lem3</i> Δ :: <i>TRP1</i> <i>crf1</i> Δ :: <i>HphMX4</i> <i>cfs1</i> Δ :: <i>CaURA3</i>	This study
YKT2018	<i>MATa</i> <i>TRP1</i> :: <i>P_{GALI}</i> -NEO1	This study
YKT2085	<i>MATa</i> <i>TRP1</i> :: <i>P_{GALI}</i> -NEO1 <i>cfs1</i> Δ :: <i>CaURA3</i>	This study
YKT2086	<i>MATa</i> <i>TRP1</i> :: <i>P_{GALI}</i> -NEO1 <i>KanMX6</i> :: <i>P_{GALI}</i> -3HA-CDC50 <i>cfs1</i> Δ :: <i>CaURA3</i>	This study
YKT2087	<i>MATa</i> <i>TRP1</i> :: <i>P_{GALI}</i> -NEO1 <i>rcy1</i> Δ :: <i>HphMX4</i> <i>cfs1</i> Δ :: <i>CaURA3</i>	This study
YKT2037	<i>MATa</i> <i>cfs1</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT2049	<i>MATa</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>lem3</i> Δ :: <i>TRP1</i> <i>cfs1</i> Δ :: <i>KanMX4</i>	This study
YKT2050	<i>MATa</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>lem3</i> Δ :: <i>TRP1</i> <i>crf1</i> Δ :: <i>HphMX4</i> <i>cfs1</i> Δ :: <i>KanMX4</i>	This study
YKT2088	<i>MATa</i> <i>cdc50</i> Δ :: <i>HIS3MX6</i> <i>lem3</i> Δ :: <i>TRP1</i> <i>crf1</i> Δ :: <i>HphMX4</i> <i>kes1</i> Δ :: <i>KanMX4</i>	This study
YKT2051	<i>MATa</i> <i>neol</i> Δ :: <i>HIS3MX6</i> <i>cfs1</i> Δ :: <i>HphMX4</i> <i>TRP1</i>	This study
YKT1523	<i>MATa</i> <i>URA3</i> :: <i>P_{TPH}</i> -GFP-SNC1 <i>TRP1</i>	Takeda <i>et al.</i> 2014
YKT2055	<i>MATa</i> <i>URA3</i> :: <i>P_{TPH}</i> -GFP-SNC1 <i>cfs1</i> Δ :: <i>HIS3MX4</i> <i>TRP1</i>	This study

Strain	Genotype	Source or reference
YKT2056	<i>MATa URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 TRP1</i>	This study
YKT2057	<i>MATα URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 cfs1Δ::HIS3MX4 TRP1</i>	This study
YKT2058	<i>MATa URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 lem3Δ::TRP1</i>	This study
YKT2059	<i>MATα URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 lem3Δ::TRP1 cfs1Δ::HIS3MX4</i>	This study
YKT2060	<i>MATα URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 lem3Δ::TRP1 crf1Δ::HphMX4</i>	This study
YKT2061	<i>MATα URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-CDC50 lem3Δ::TRP1 crf1Δ::HphMX4 cfs1Δ::HIS3MX4</i>	This study
YKT2062	<i>MATα URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-NEO1 TRP1</i>	This study
YKT2063	<i>MATa URA3::P_{TPH}-GFP-SNC1 KanMX6::P_{GALI}-3HA-NEO1 cfs1Δ::HIS3MX4 TRP1</i>	This study
YKT2093	<i>MATa/α CFS1-EGFP::KanMX6/CFS1-EGFP::KanMX6 DRS2-mRFP1::TRP1/DRS2-mRFP1::TRP1</i>	This study
YKT2094	<i>MATa/α CFS1-EGFP::KanMX6/CFS1-EGFP::KanMX6 NEO1-mRFP1::TRP1/NEO1-mRFP1::TRP1</i>	This study
YKT2111	<i>MATa/α CFS1-EGFP::KanMX6/CFS1-EGFP::KanMX6 SEC7-mRFP1::TRP1/SEC7-mRFP1::TRP1</i>	This study
YKT2020	<i>MATa ric1Δ::TRP1</i>	This study
YKT2033	<i>MATa ric1Δ::TRP1 cfs1Δ::HIS3MX4</i>	This study
YKT2022	<i>MATa rgp1Δ::TRP1</i>	This study
YKT2034	<i>MATa rgp1Δ::TRP1 cfs1Δ::HIS3MX4</i>	This study
YKT2095	<i>MATa URA3::P_{TPH}-GFP-SNC1 ric1Δ::TRP1</i>	This study
YKT2096	<i>MATa URA3::P_{TPH}-GFP-SNC1 ric1Δ::TRP1 cfs1Δ::HIS3MX4</i>	This study
YKT2097	<i>MATa URA3::P_{TPH}-GFP-SNC1 rgp1Δ::TRP1</i>	This study
YKT2098	<i>MATa URA3::P_{TPH}-GFP-SNC1 rgp1Δ::TRP1 cfs1Δ::HIS3MX4</i>	This study
YKT715	<i>MATa lem3Δ::TRP1</i>	Saito <i>et al.</i> 2004
YKT2099	<i>MATa lem3Δ::TRP1 cfs1Δ::KanMX4</i>	This study
YKT2100	<i>MATa ENA1-GFP::KanMX6 trp1Δ-63</i>	This study
YKT2101	<i>MATα ENA1-GFP::KanMX6 cfs1Δ::HphMX4 trp1Δ-63</i>	This study
YKT2102	<i>MATα ENA1-GFP::KanMX6 neo1Δ::HIS3MX6 cfs1Δ::HphMX4 trp1Δ-63</i>	This study
YKT2074	<i>MATa sec14-3 TRP1</i>	This study
YKT2075	<i>MATa sec14-3 kes1Δ::KanMX4 TRP1</i>	This study
YKT2076	<i>MATa sec14-3 cfs1Δ::HphMX4 TRP1</i>	This study
YKT1638	<i>MATa HphMX4::P_{GALI}-3HA-CDC50 trp1Δ-63</i>	This study
YKT2069	<i>MATa TRP1::P_{GALI}-NEO1 kes1Δ::KanMX4</i>	This study

Strain	Genotype	Source or reference
YKT2104	<i>MATa URA3::P_{TPH}-GFP-SNC1 neo1Δ::HIS3MX6 cfs1Δ::HphMX4 TRP</i>	This study
YKT38	<i>MATa his3Δ-200 leu2Δ-1 lys2-82 trp1Δ-63 ura3-52</i>	Mochida <i>et al.</i> 2002
YKT2079	<i>MATa CFS1-EGFP::KanMX4 trp1Δ-63</i>	This study
YKT2105	<i>MATa CFS1-EGFP::KanMX4 cdc50Δ::HIS3MX6 trp1Δ-63</i>	This study
YKT2106	<i>MATa CFS1-EGFP::KanMX4 vrp1Δ::LEU2 trp1Δ-63</i>	This study
YKT2064	<i>MATa cfs1Δ::HphMX4 trp1Δ-63</i>	This study
BY4719	<i>MATa HIS3 LEU2 LYS2 MET15 trp1Δ-63 ura3Δ0</i>	Brachmann <i>et al.</i> 1998
BY4741	<i>MATa his3Δ1 leu2Δ0 LYS2 met15Δ0 TRP1 ura3Δ0</i>	Brachmann <i>et al.</i> 1998
BY4743	<i>MATa/α his3Δ1/his3Δ1 leu2Δ0/leu2Δ0 LYS2/lys2Δ0 met15Δ0/MET15 TRP1/TRP1 ura3Δ0/ura3Δ0</i>	Brachmann <i>et al.</i> 1998
KKT3	<i>MATα his3Δ1 leu2Δ0 lys2Δ0 met15Δ0 TRP1 ura3Δ0</i> (BY4743-derived)	This study
KKT9	<i>MATα cdc50Δ::HphMX4</i> (KKT3-derived)	Kishimoto <i>et al.</i> 2003
KKT479	<i>MATa cfs1Δ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT480	<i>MATa cfs1Δ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT481	<i>MATa ers1Δ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT482	<i>MATa ers1Δ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT483	<i>MATa ydr090cΔ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT484	<i>MATa ydr090cΔ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT485	<i>MATa ypq1Δ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT486	<i>MATa ypq1Δ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT487	<i>MATa ypq2Δ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT488	<i>MATa ypq2Δ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT489	<i>MATa ypq3Δ::KanMX4</i> (BY4741-derived)	a gift from C. Boone
KKT490	<i>MATa ypq3Δ::KanMX4 cdc50Δ::HphMX4</i>	This study
KKT473	<i>MATa his3Δ1 leu2Δ0 lys2Δ0 met15Δ0 trp1Δ-63 ura3Δ0</i>	This study
KKT475	<i>MATa cfs1Δ::HIS3MX4 trp1Δ-63</i> (KKT473-derived)	This study
KKT476	<i>MATa lem3Δ::KanMX4 trp1Δ-63</i> (KKT473-derived)	This study
KKT477	<i>MATa lem3Δ::KanMX4 cfs1Δ::HIS3MX4 trp1Δ-63</i> (KKT473-derived)	This study
KKT61	<i>MATa his3Δ1 leu2Δ0 lys2Δ0 MET15 TRP1 ura3Δ0</i>	Nakano <i>et al.</i> 2008
KKT478	<i>MATa cfs1Δ::KanMX4 TRP1</i> (KKT61-derived)	This study

YKT strains are isogenic derivatives of YEF473.

KKT strains were constructed using S288C-derived strains, BY4719, BY4741, and BY4743.

Only relevant genotypes are described.

References

- Bi, E., and J. R. Pringle, 1996 *ZDS1* and *ZDS2*, genes whose products may regulate Cdc42p in *Saccharomyces cerevisiae*. *Mol. Cell. Biol.* 16: 5264–5275.
- Brachmann, C. B., A. Davies, G. J. Cost, E. Caputo, J. Li *et al.*, 1998 Designer deletion strains derived from *Saccharomyces cerevisiae* S288C: a useful set of strains and plasmids for PCR-mediated gene disruption and other applications. *Yeast* 14: 115–132.
- Kishimoto, T., T. Yamamoto, and K. Tanaka, 2005 Defects in structural integrity of ergosterol and the Cdc50p-Drs2p putative phospholipid translocase cause accumulation of endocytic membranes, onto which actin patches are assembled in yeast. *Mol. Biol. Cell* 16: 5592–5609.
- Misu, K., K. Fujimura-Kamada, T. Ueda, A. Nakano, H. Katoh *et al.*, 2003 Cdc50p, a conserved endosomal membrane protein, controls polarized growth in *Saccharomyces cerevisiae*. *Mol. Biol. Cell* 14: 730–747.
- Mochida, J., T. Yamamoto, K. Fujimura-Kamada, and K. Tanaka, 2002 The novel adaptor protein, Mtl1p, and Vrp1p, a homolog of Wiskott-Aldrich syndrome protein-interacting protein (WIP), may antagonistically regulate type I myosins in *Saccharomyces cerevisiae*. *Genetics* 160: 923–934.
- Nakano K., T. Yamamoto, T. Kishimoto, T. Noji, and K. Tanaka, 2008 Protein kinases Fpk1p and Fpk2p are novel regulators of phospholipid asymmetry. *Mol Biol Cell.* 19: 1783–1797.
- Saito, K., K. Fujimura-Kamada, N. Furuta, U. Kato, M. Umeda *et al.*, 2004 Cdc50p, a protein required for polarized growth, associates with the Drs2p P-Type ATPase implicated in phospholipid translocation in *Saccharomyces cerevisiae*. *Mol. Biol. Cell* 15: 3418–3432.
- Takeda, M., K. Yamagami, and K. Tanaka, 2014 Role of phosphatidylserine in phospholipid flippase-mediated vesicle transport in *Saccharomyces cerevisiae*. *Eukaryot. Cell* 13: 363–375.
- Yamagami, K., T. Yamamoto, S. Sakai, T. Mioka, T. Sano *et al.*, 2015 Inositol depletion restores vesicle transport in yeast phospholipid flippase mutants. *PLoS One* 10: e0120108.
- Zendehebodi, Z., T. Yamamoto, H. Sakane, and K. Tanaka, 2013 Identification of a second amphipathic lipid-packing sensor-like motif that contributes to Gcs1p function in the early endosome-to-TGN pathway. *J. Biochem.* 153: 573–587