Author Summary

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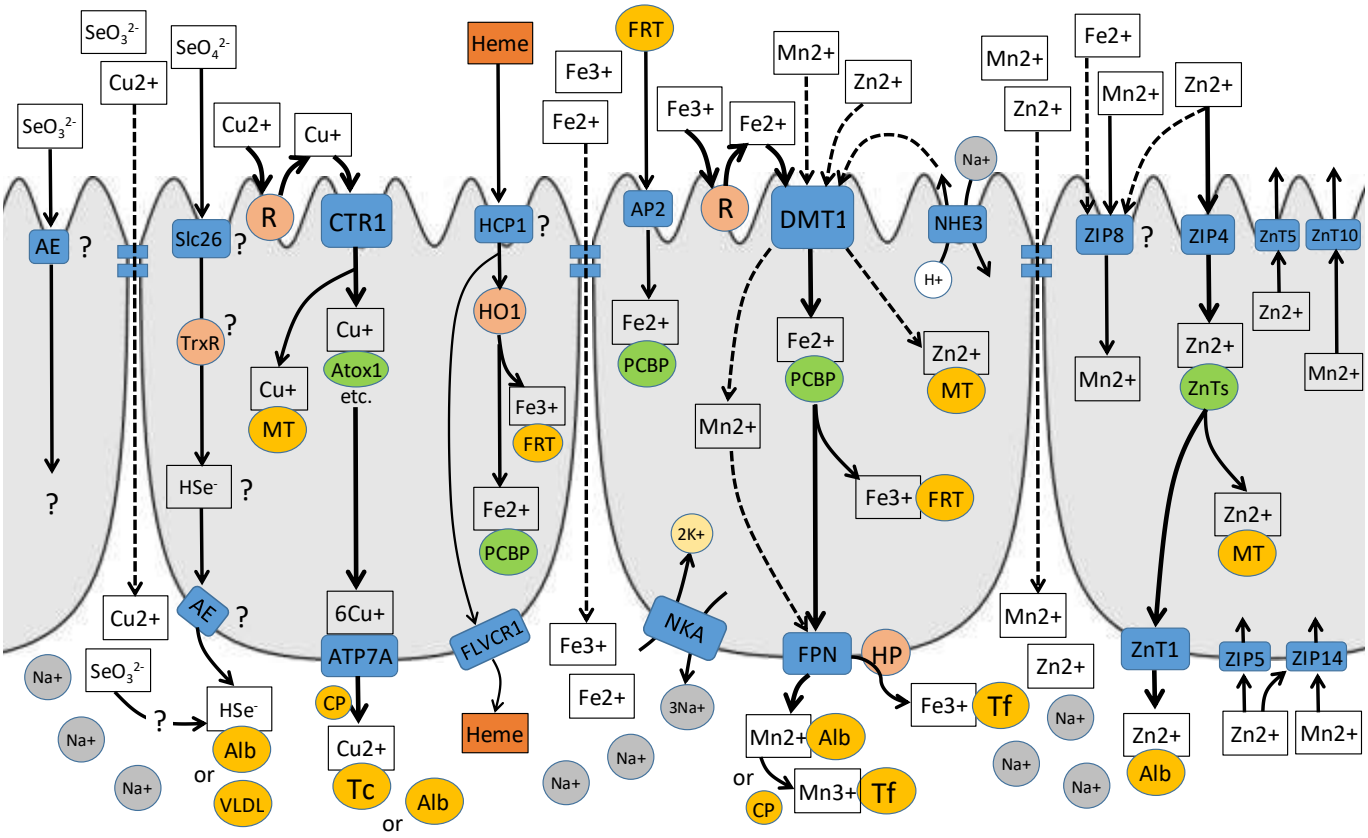

Fig. 8. Schematic diagram of trace mineral transport across the intestinal epithelium

Amino acid-bound minerals are likely transported by their respective amino acid transporters (not shown in the figure). Passive paracellular diffusion will be significant at high dietary or luminal concentrations. The same transport system may or may not be present in the gill epithelium. Also, the transporter distribution is highly variable depending on the GI region (i.e., esophagus, stomach, pyloric caeca, proximal-distal intestine, rectum). Seawater fishes possess extra transporters (not shown in the figure) along the full length of the GI tract including the esophagus for osmoregulatory purposes. As the general transport mechanism is thought to be highly conserved across vertebrates, mammalian models of metal transport are tentatively incorporated in the present figure where the piscine model is not fully defined. For details, refer to the text.

Abbreviations AE: anion exchanger, Alb: albumin, AP2: adaptor-related 2 protein, Atox1: antioxidant 1 (Cu-chaperone), Cp: Ceruloplasmin (Cu-binding glycoprotein with ferroxidase activity), CTR1: Cu-uptake protein 1 (Slc31a1), DMT1: divalent metal transporter 1 (Slc11a2), FLVCR: feline leukemia virus C receptor protein, FPN1: ferroportin 1 (=Ireg1; Slc40a1), FRT: ferritin, HCP1: heme carrier protein 1, HO1: heme oxygenase 1, HP: HEPH or hephaestin (multi-copper ferrioxidase), HRG: heme responsive gene, MT: metallothionein, NHE3: Na+/H+ exchanger 3 (Slc9a3), NKA: Na+/K+ ATPase, PCBP: poly (rC) binding protein 1/2, R: Reductases (e.g., Dcytb or duodenal cytochrome B; STEAPs or six-transmembrane epithelial antigen of the prostate), Slc26: multifunctional anion exchangers, Tc: transcuprein (α2-macroglobulin), Tf: transferrin, TrxR: thioredoxin reductases, VLDL: Very low density lipoprotein, ZIP14: Zinc transporter Zrt–Irt-like protein 14 (Slc39a14), ZIP8: Zinc transporter Zrt–Irt-like protein 8 (Slc39a8), ZIP5: Zinc transporter Zrt–Irt-like protein 5 (Slc39a5), ZIP4: Zinc transporter Zrt–Irt-like protein 4 (Slc39a4), ZnT1: Zinc transporter 1 (Slc30a1), ZnT5: Zinc transporter 5 (Slc30a5), ZnT10: Zinc transporter 10 (Slc30a10).