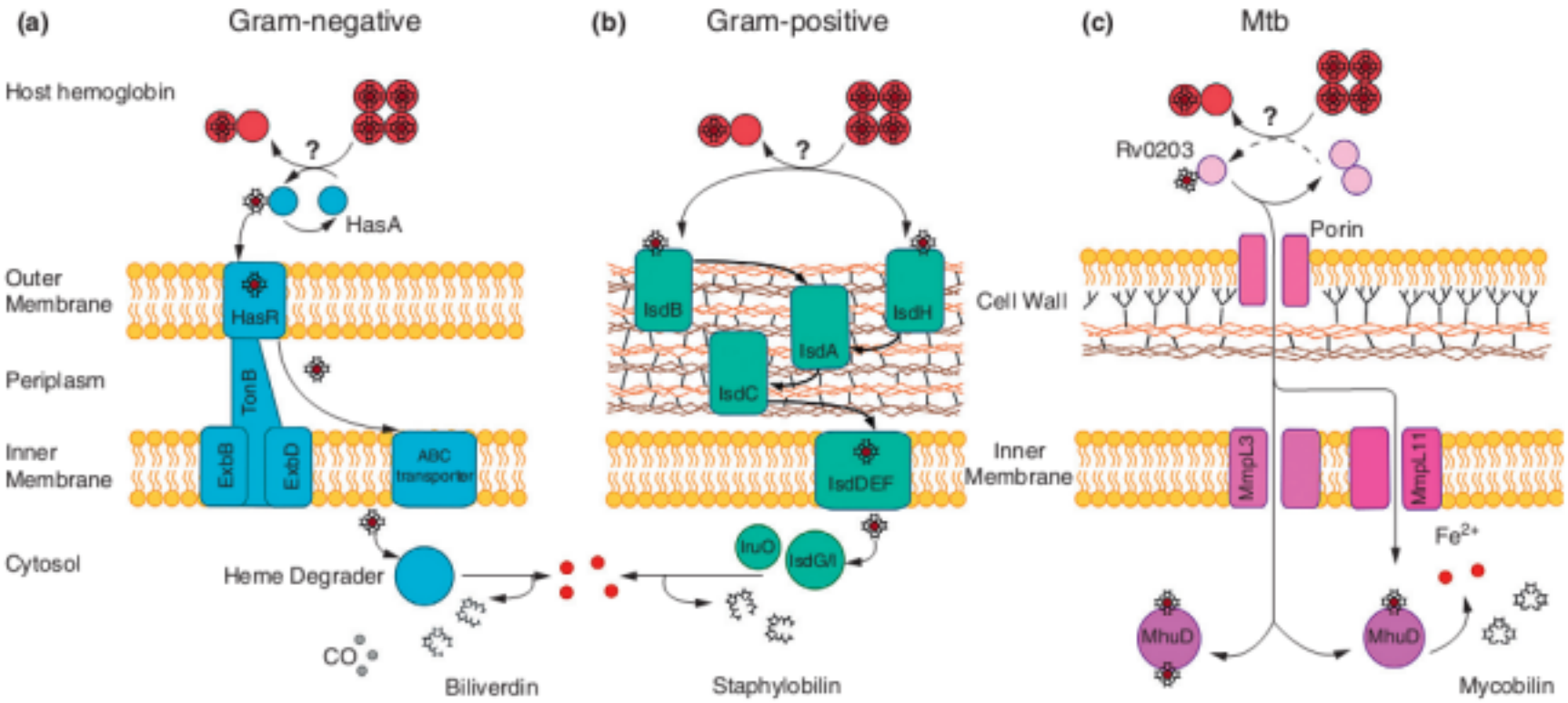
Heme Uptake in Bacterial Pathogens

Xiangzhi Liu

14/05/10

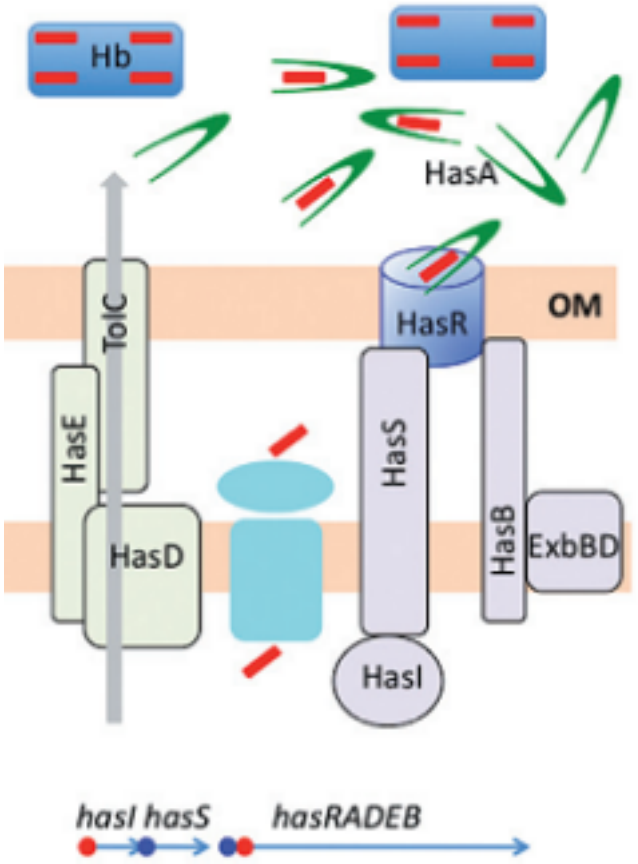
Schematic Overview of Heme Transport

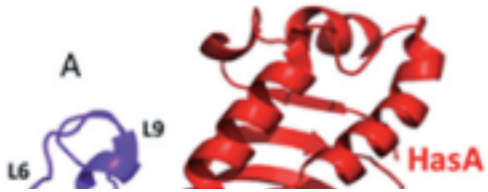


Mtb is *Mycobacterium tuberculosis*

Celia W Goulding et al. Curr Opin Chem Biol (2014)

Key Players Involved in Gram-negative Heme Uptake Pathways



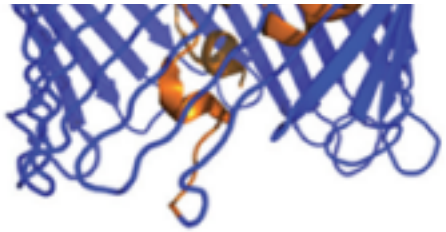


※ three domains:

N-terminal transmembrane helix anchors the protein to the inner membrane and makes contact with ExbB and ExbD

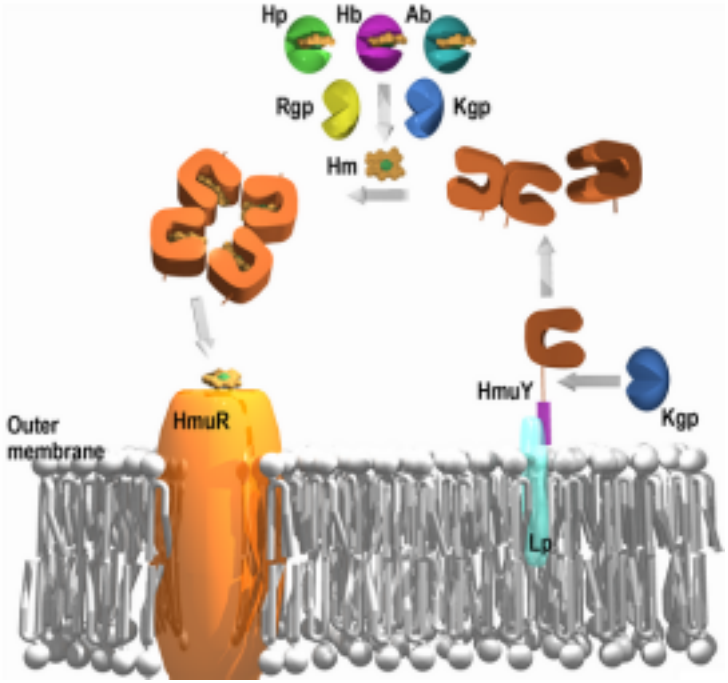
C-terminal globular domain directly contacts the transporters in the OM.

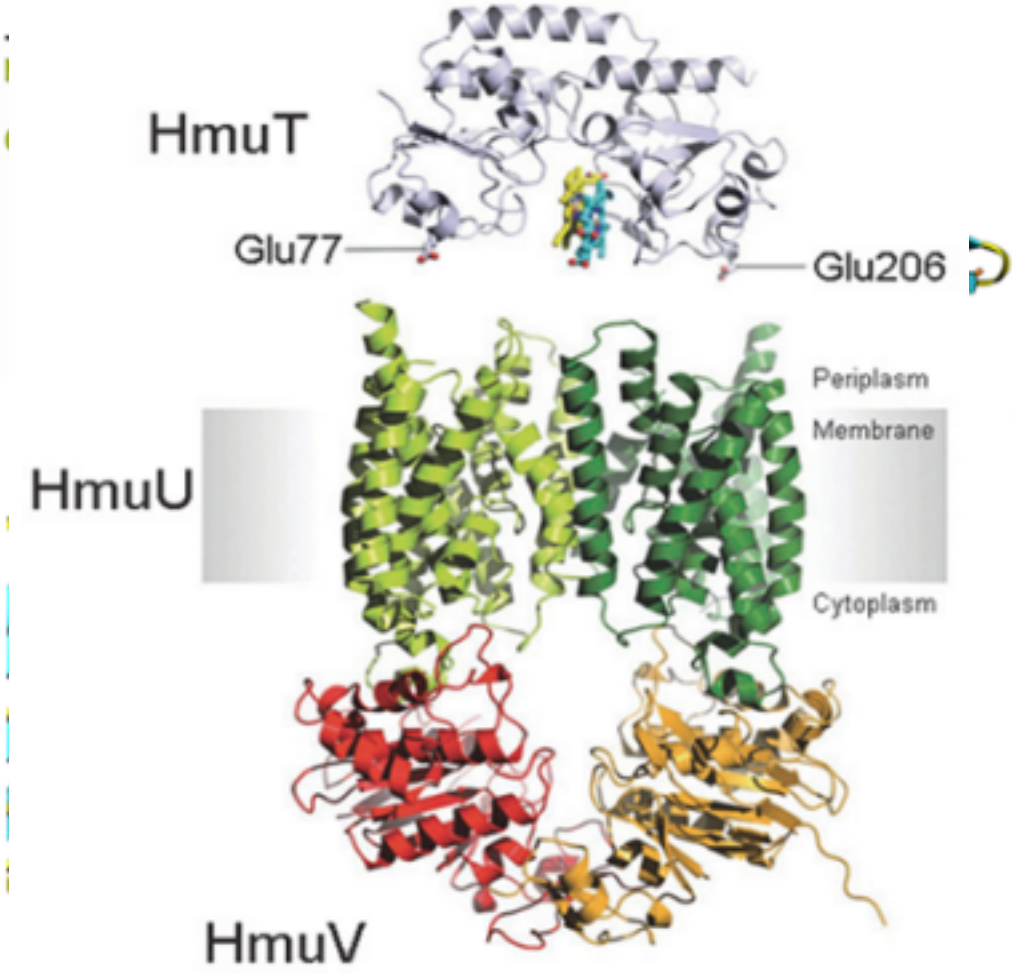
flexible, unstructured proline-rich domain that resides within the periplasm



*Philippe Delepelaire et al.*Mol Microb (2012)

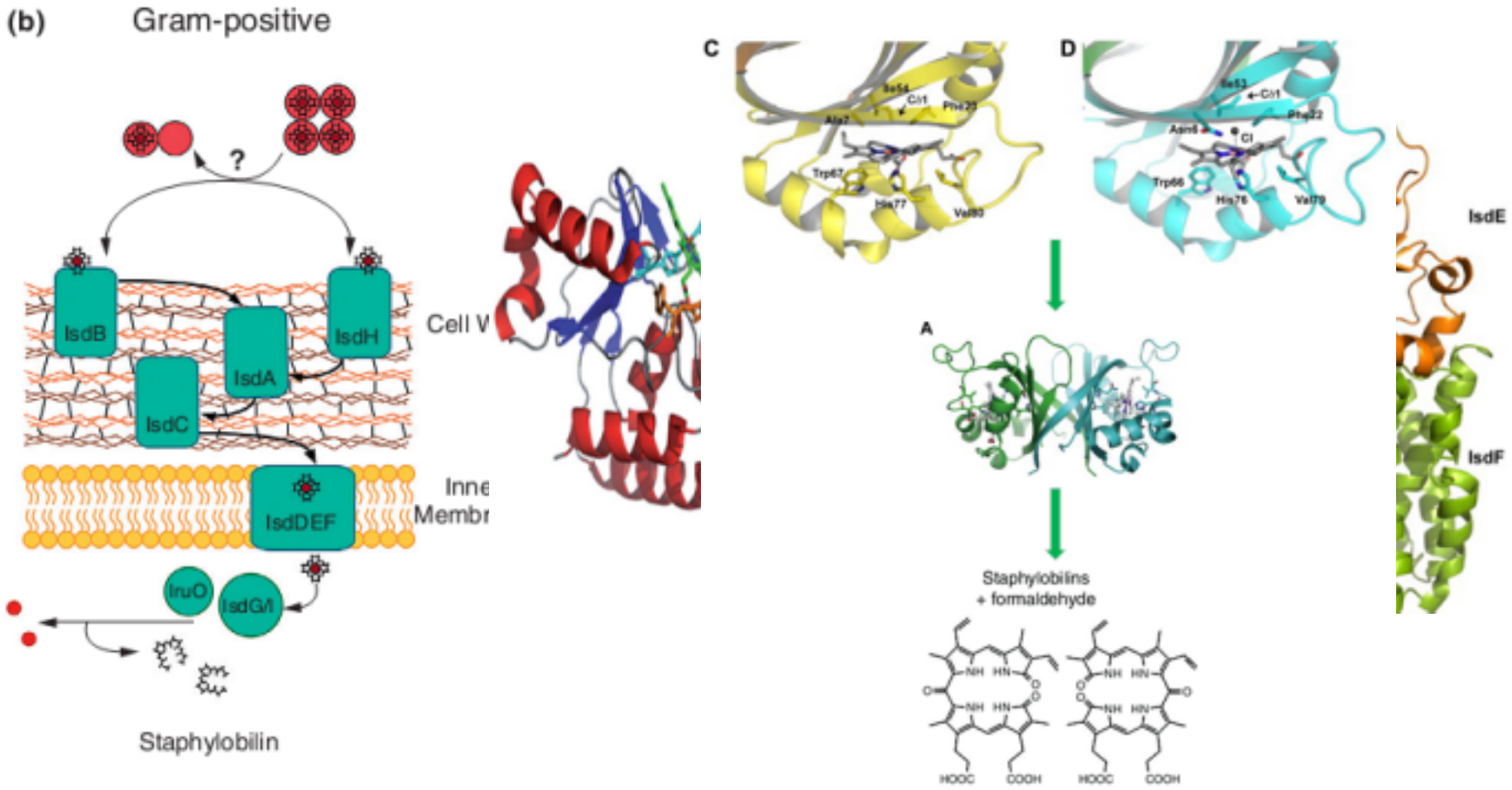
Heme Uptake Pathways in *Porphyromonas gingivalis*





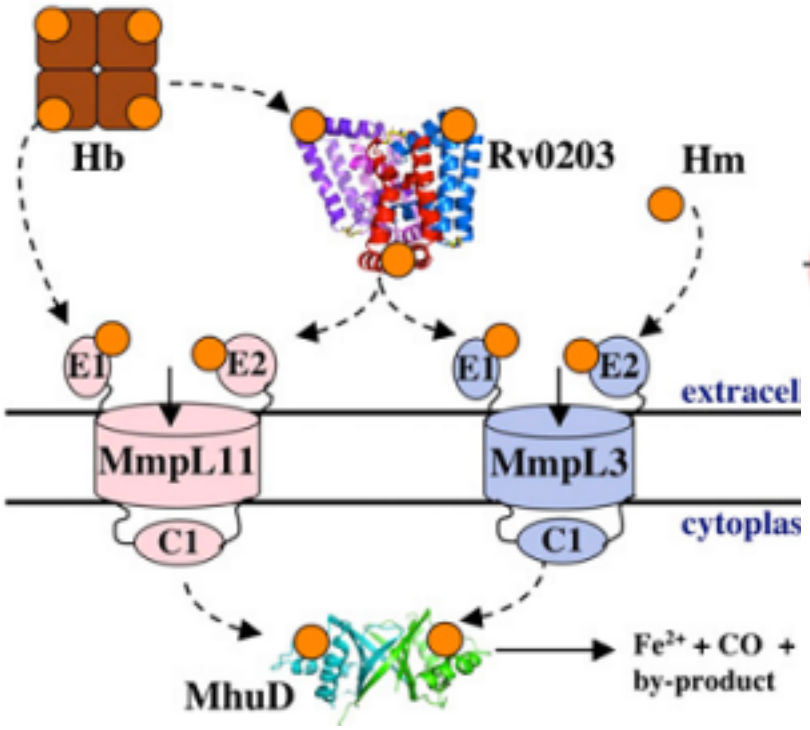
F. Xavier Gomis-Ruth et al. PLoS Pathogens(2009)

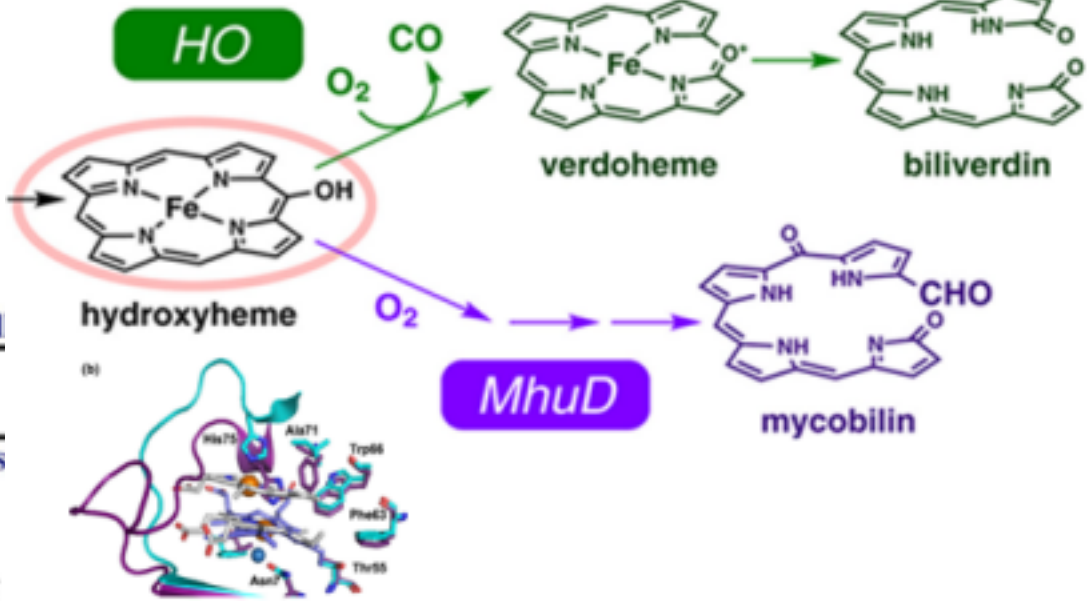
Key Players Involved in Gram-positive Heme Uptake Pathways



M.E. Murphy et al. J Inorg Biochem(2010)

Heme Uptake Pathways in *Mycobacterium tuberculosis*

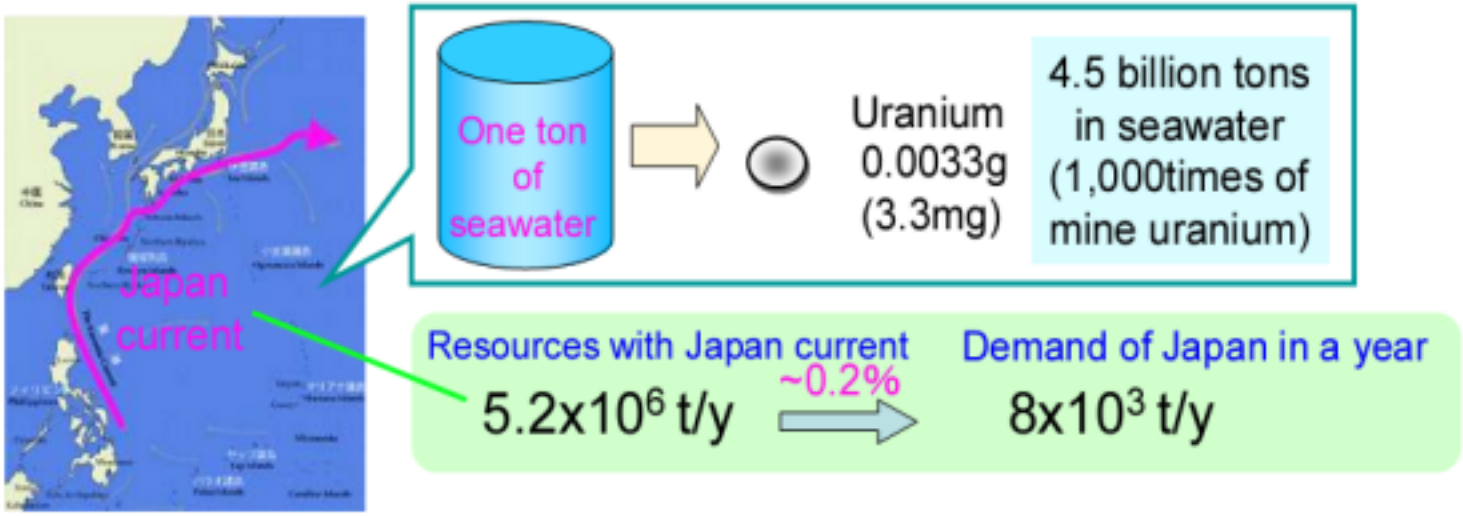




Celia W. Goulding et al. Proc Natl Acad Sci USA(2011)

Collection of Uranium from Seawater in Japan

Uranium Resource in Seawater



Uranium

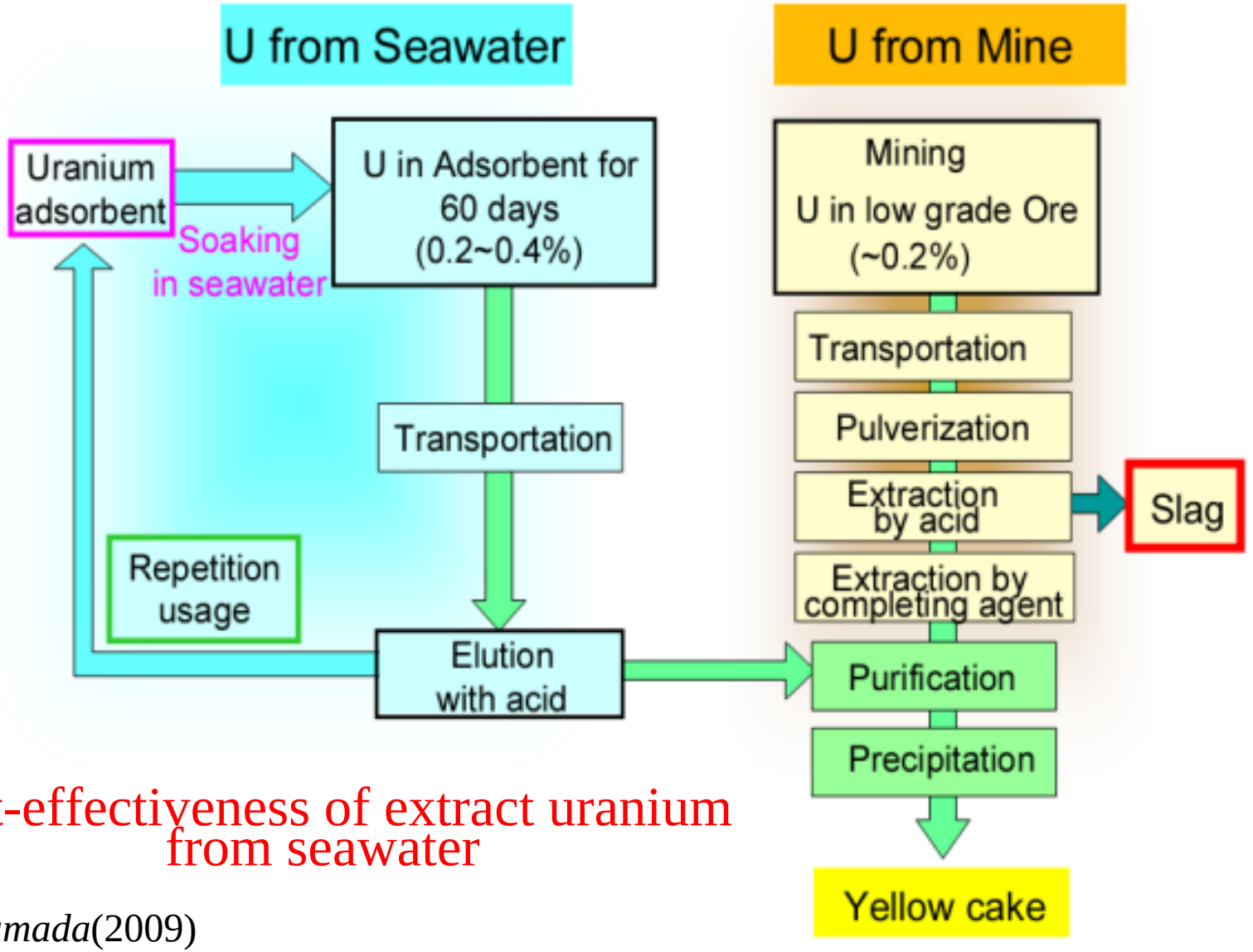
※ 3.3 ppb in seawater
※ near boundary of cost-effectiveness

→ commercialization of uranium collection from seawater

How do we develop a cost-effective methods?

Masao Tamada(2009)

Process of Uranium Collection with Adsorbent



cost-effectiveness of extract uranium from seawater

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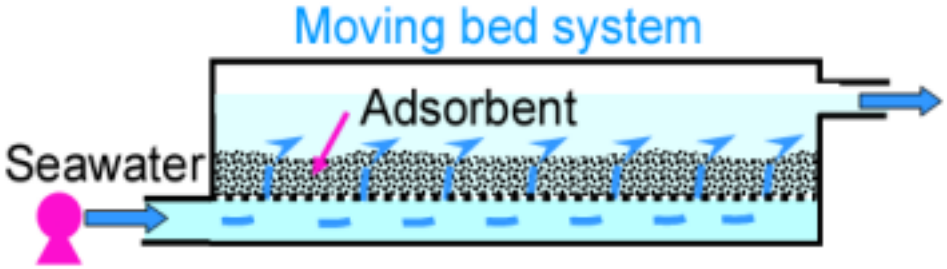
Uranium Adsorbent

~1960

Hydrous titanium oxide adsorbent

Inorganic material

Pumping for preventing adsorbent from sinking

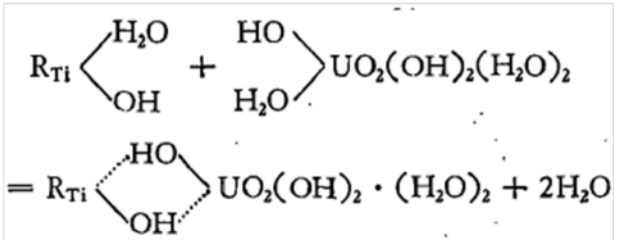


Costly process
Low mechanical strength

Hydrous titanium oxide

structure

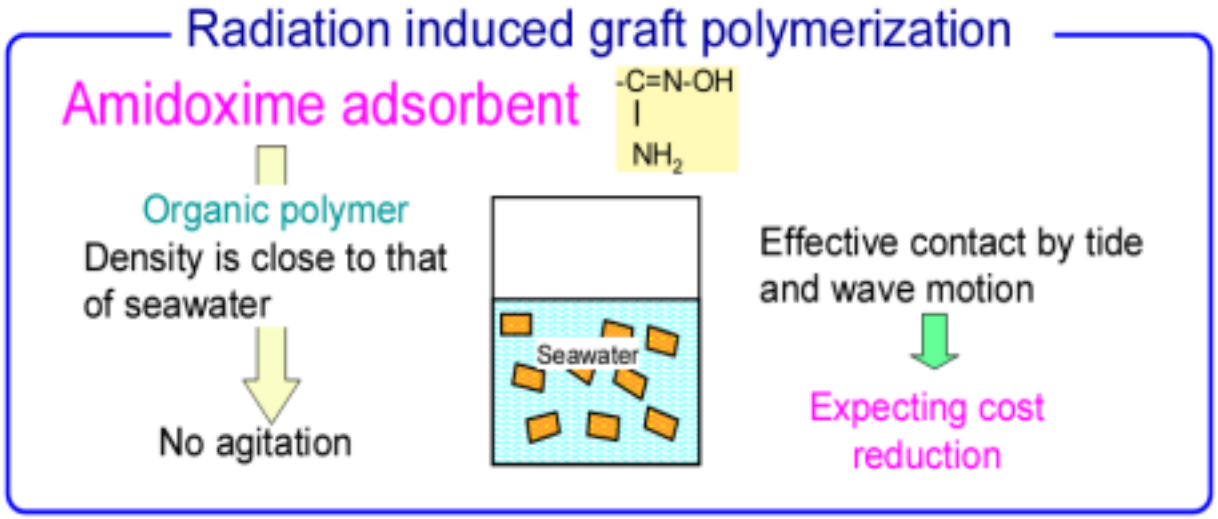
probable adsorption mechanism



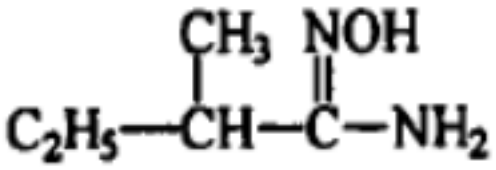
Y Fujiki et al.Inor Chem(1985)

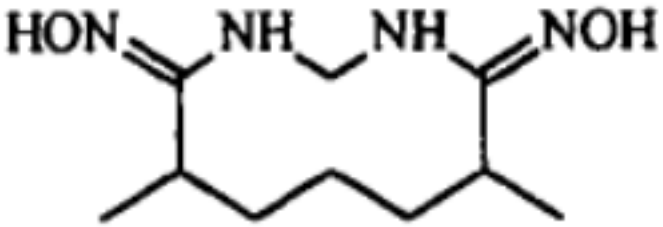
Uranium Adsorbent

~1980



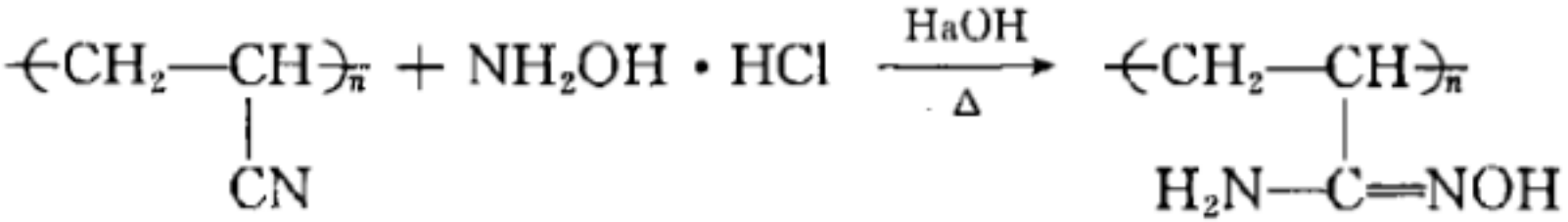
Conventional structure



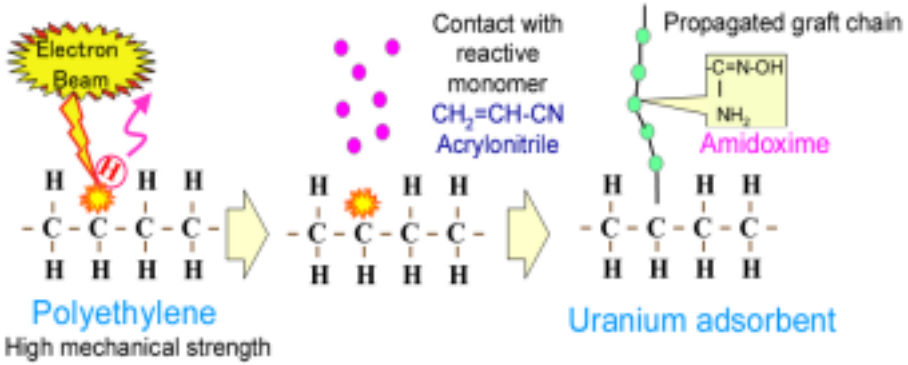


Graft Polymerization

chemical-induced Graft Polymerization



radiation-induced Graft Polymerization



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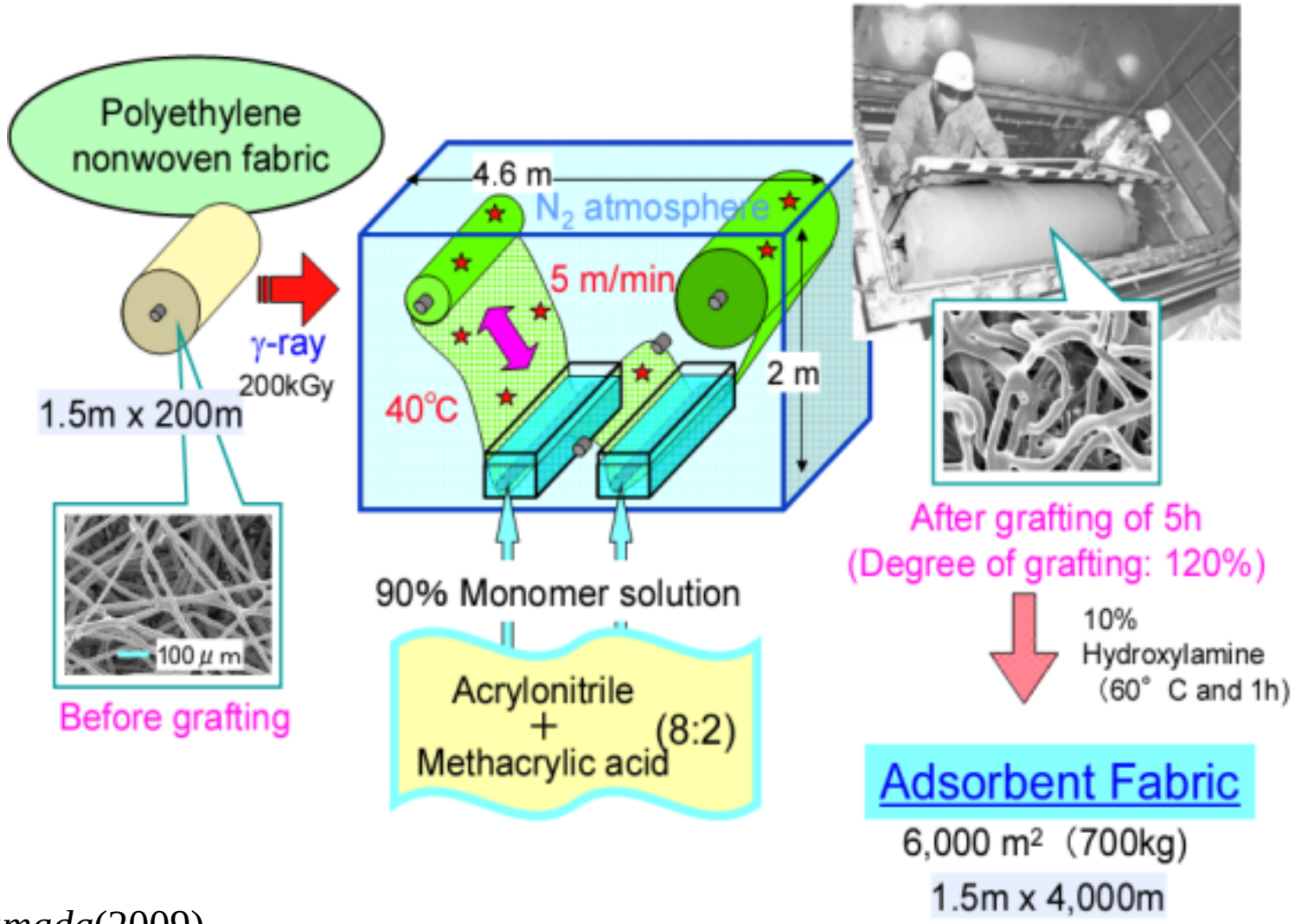
Mass Production of Adsorbent Fabric



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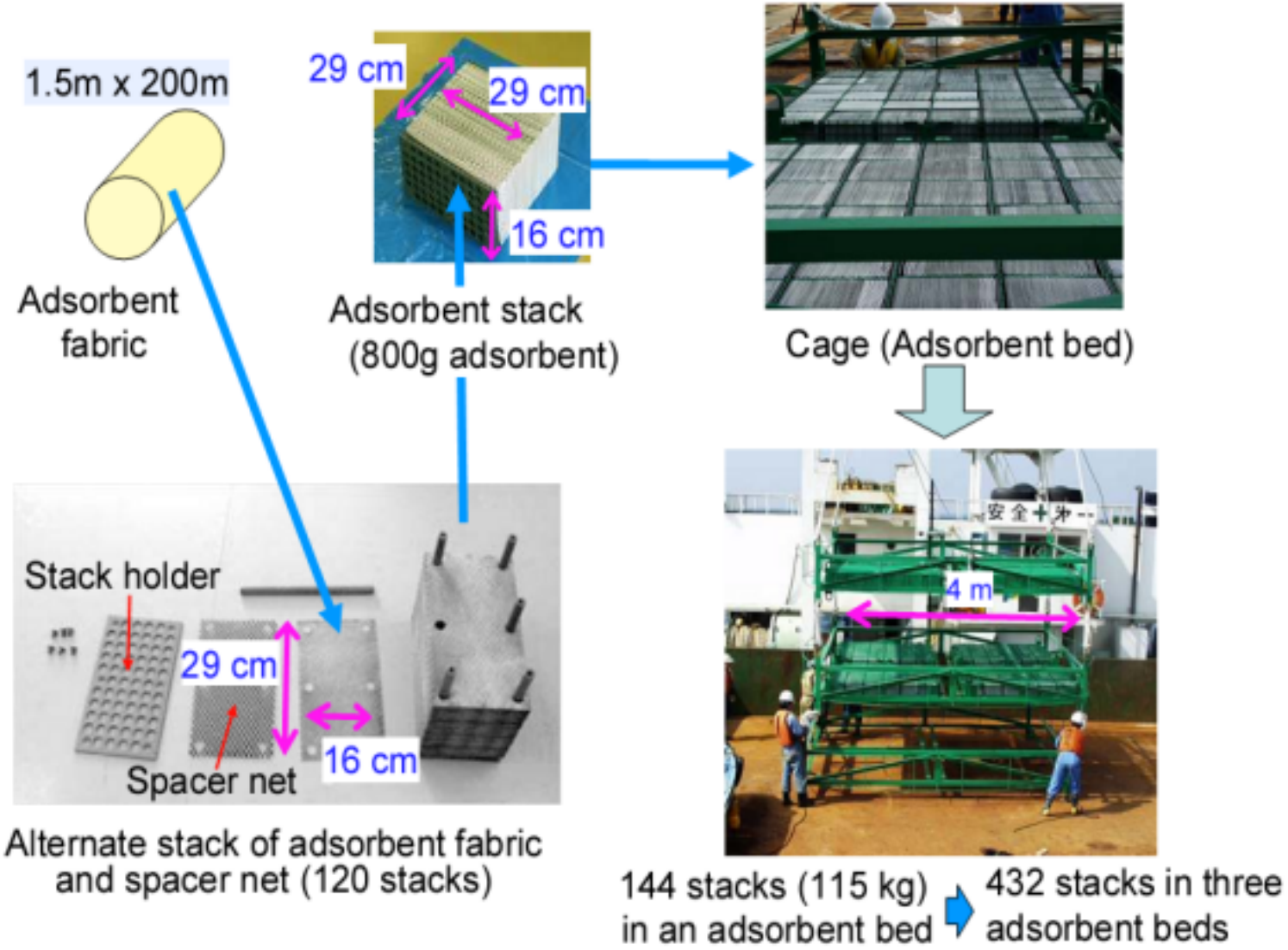
Adsorbent Fabric Stacks and Cages



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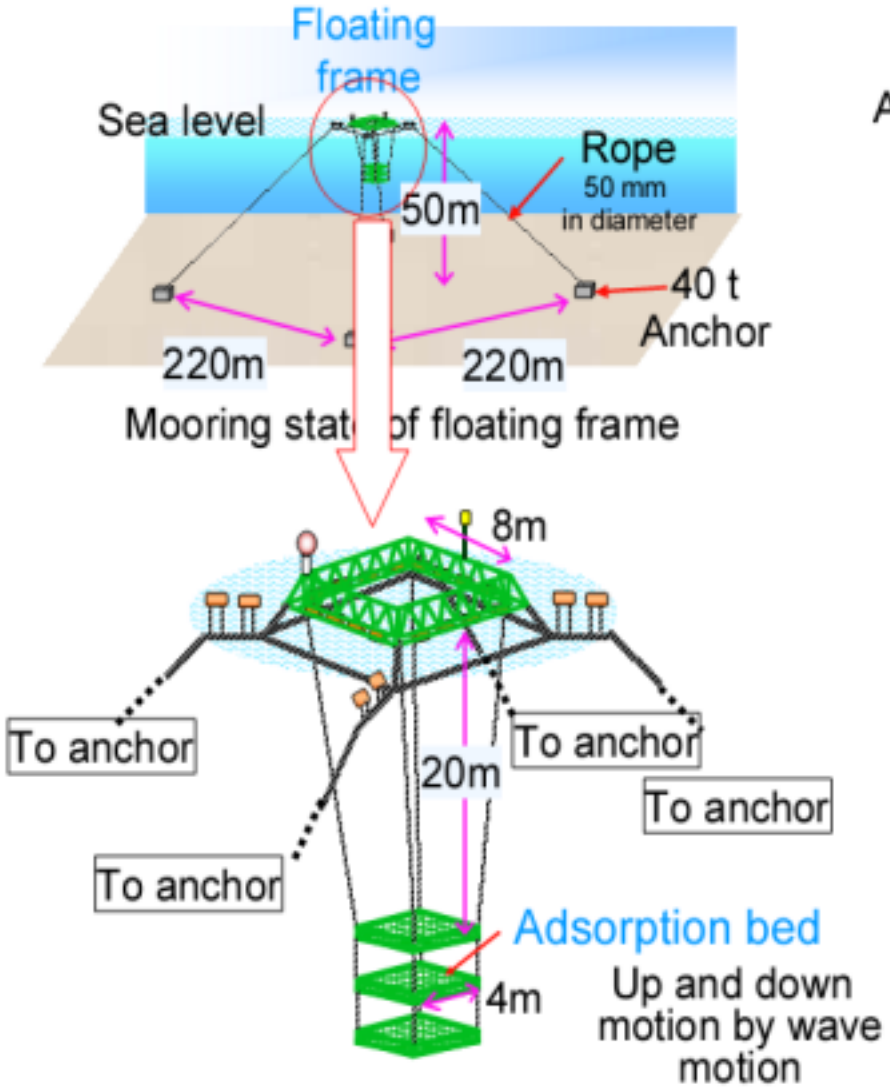
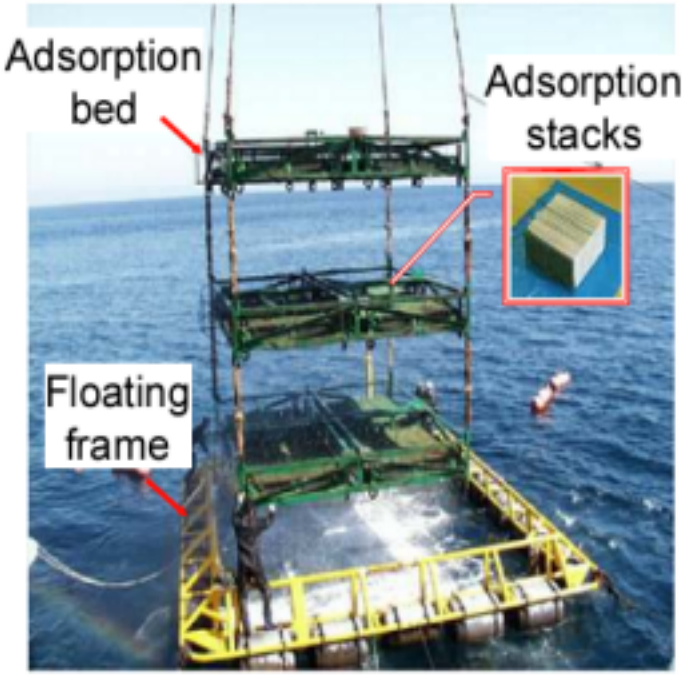
Marine Equipment for Uranium Recovery





Drawing up of adsorption bed packed with adsorbent stacks at northern sea in Japan

(350 kg in three adsorbent beds)

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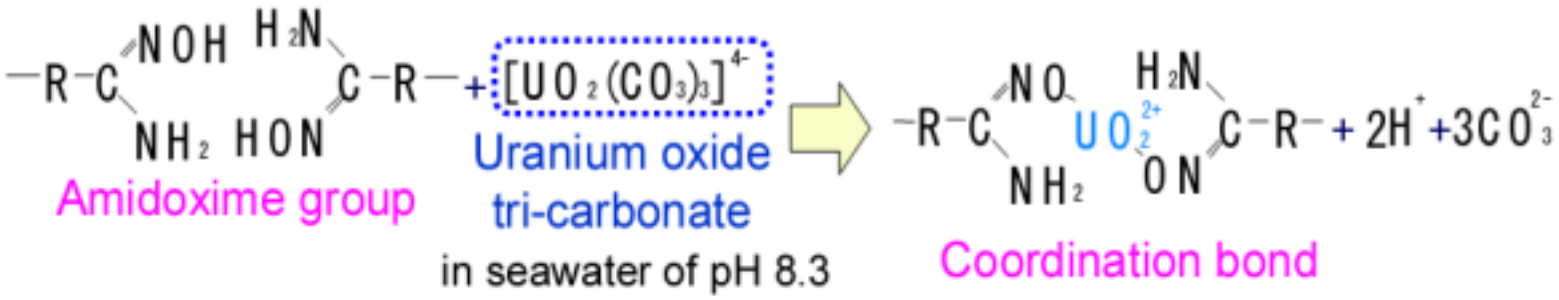
Characteristic of Amidoxime Adsorbent



Selectivity of amidoxime adsorbent

Elements	Concentration in seawater[a](μg/L)	Concentration in adsorbent[b](μg/g-ad)	Distribution coefficient(b/1000a)
Na	1.08×10^{7}	618.5	0.057
K	3.80×10^{5}	45.9	0.12
Al	2	86.94	4.35×10^{3}
Pb	0.003	108.82	3.62×10^{6}
Ti	1	1.49	1.49×10^{3}
Fe	2	414.44	2.07×10^{5}
Co	0.05	23.57	4.71×10^{5}
Ni	1.7	78.17	4.60×10^{4}
U	3.2	63.72	1.99×10^{4}

Adsorption conditions:0.2 g adsorbent 25℃、3L/min seawater, and 7 days.

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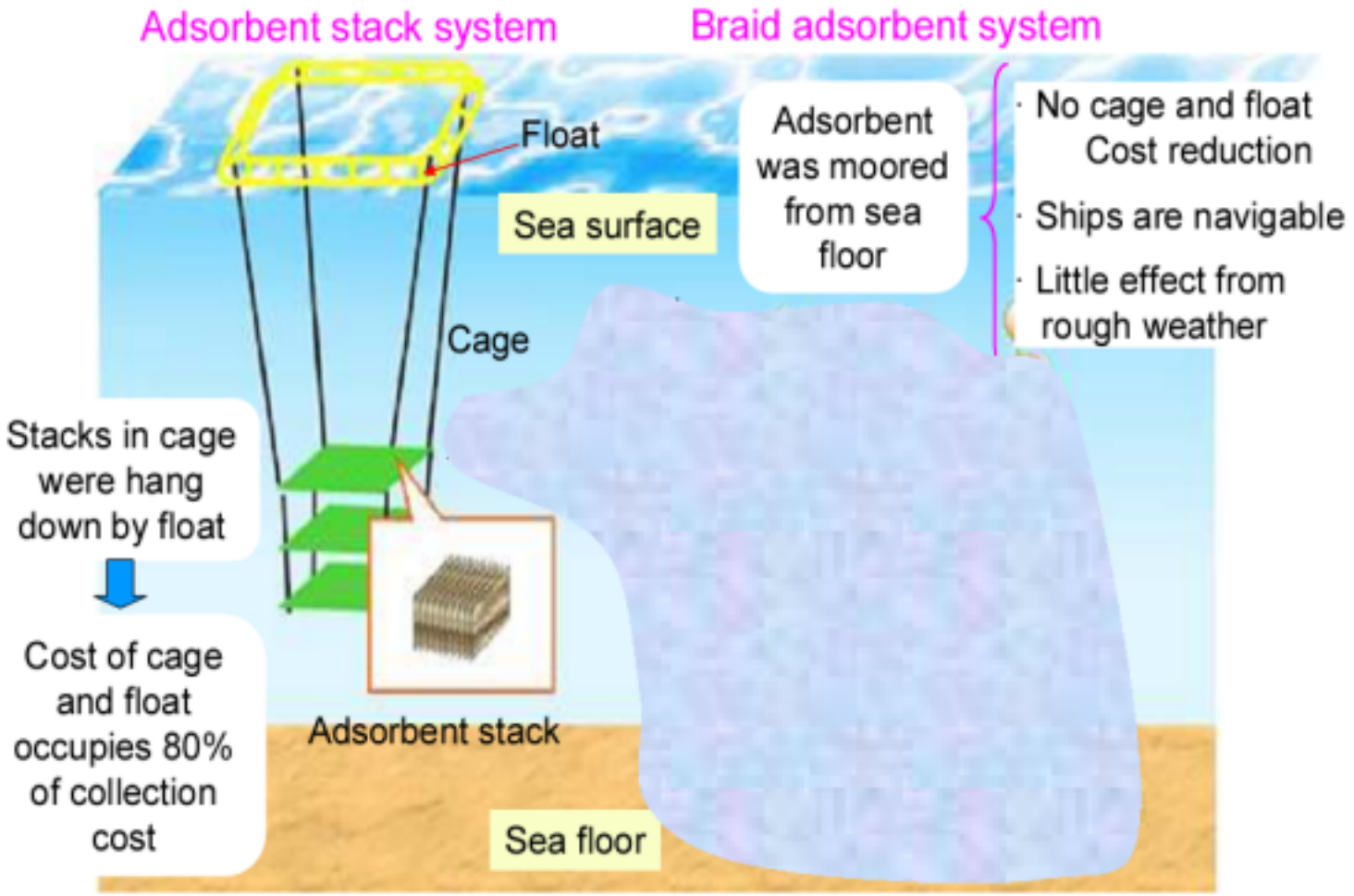
New Collection System for Cost Reduction



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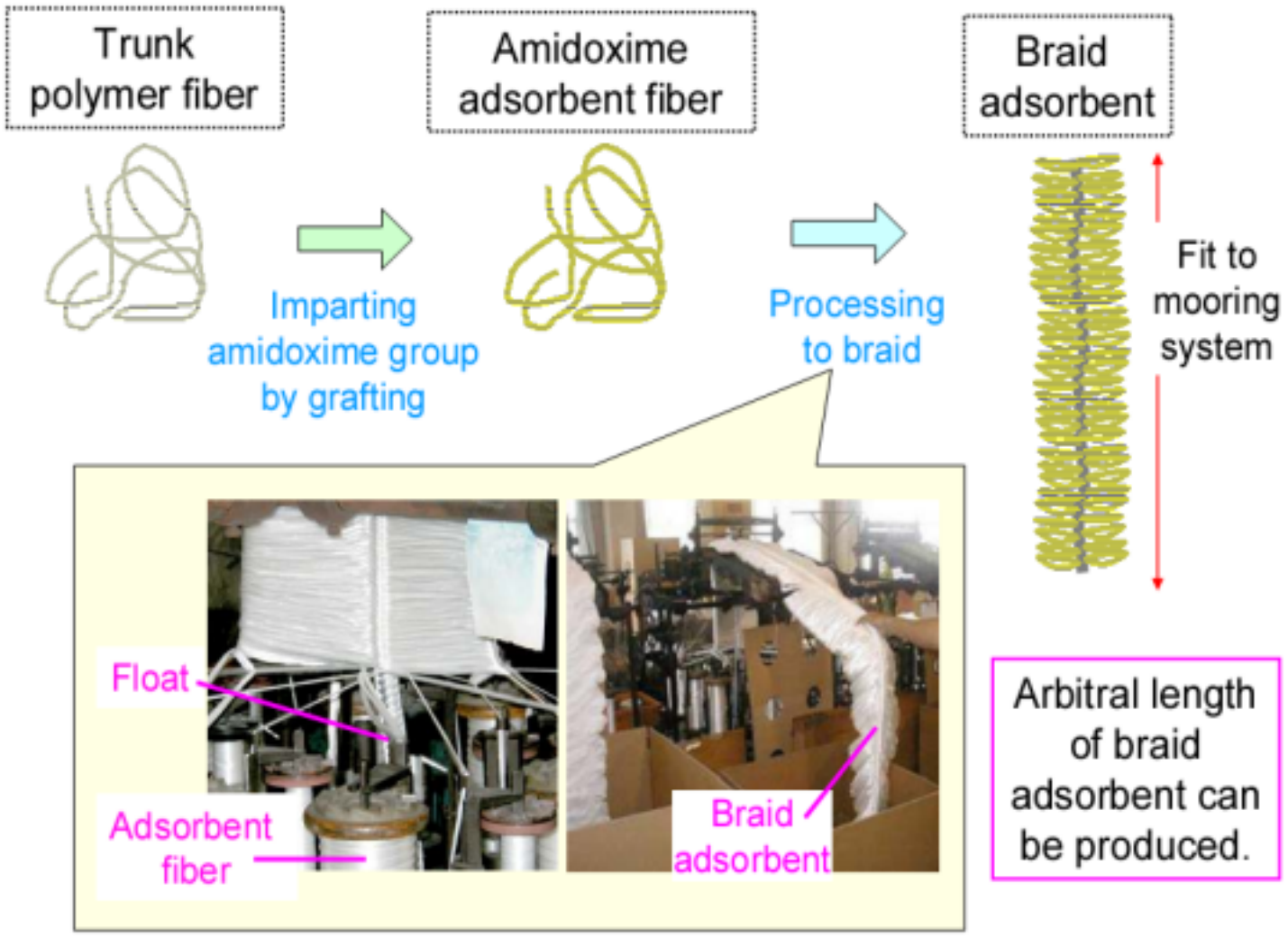
Production of Braid Type Adsorbent



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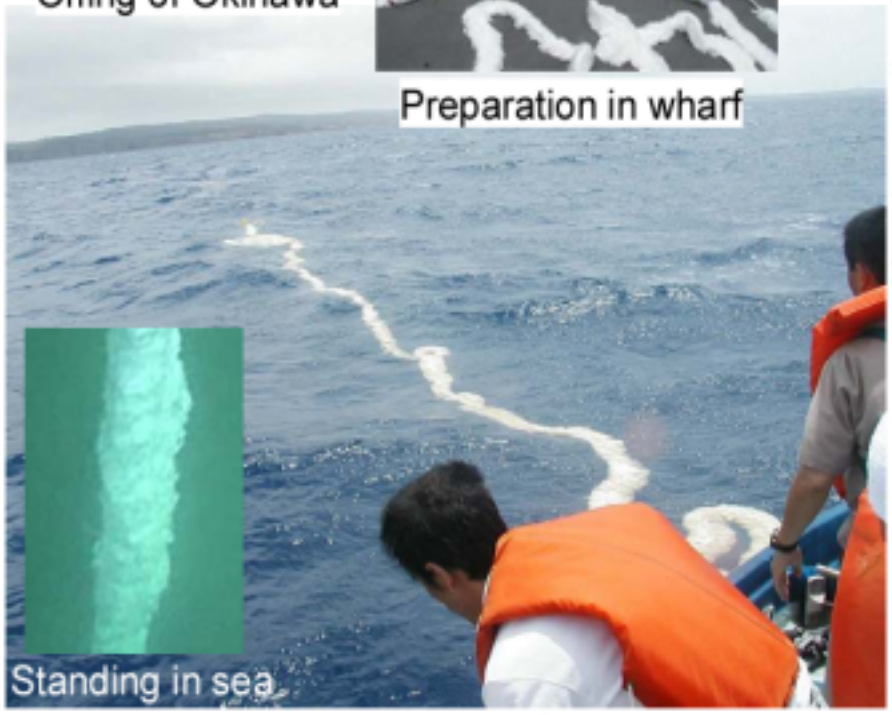
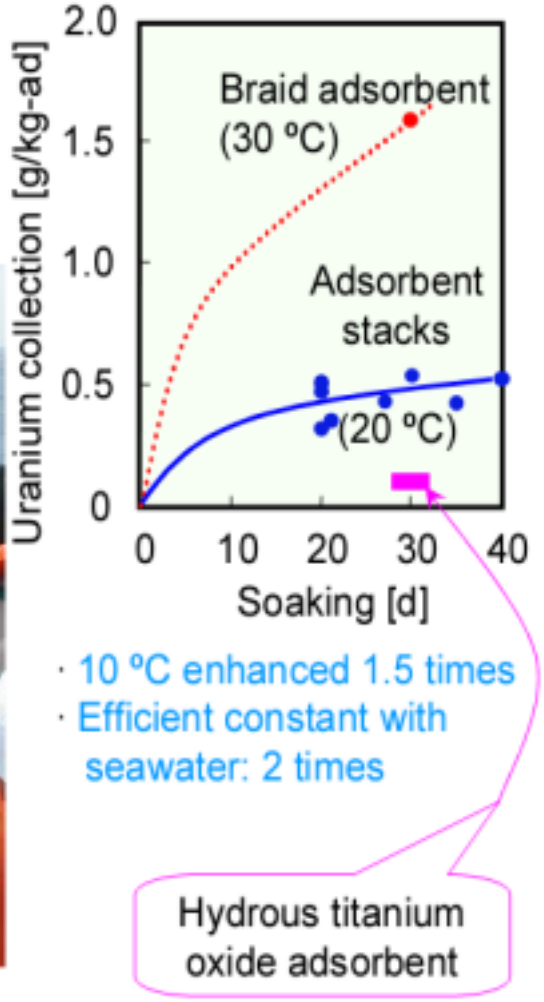
Marine Experiment for Braid Adsorbent

Offing of Okinawa

Preparation in wharf



Recovery operation of adsorbent



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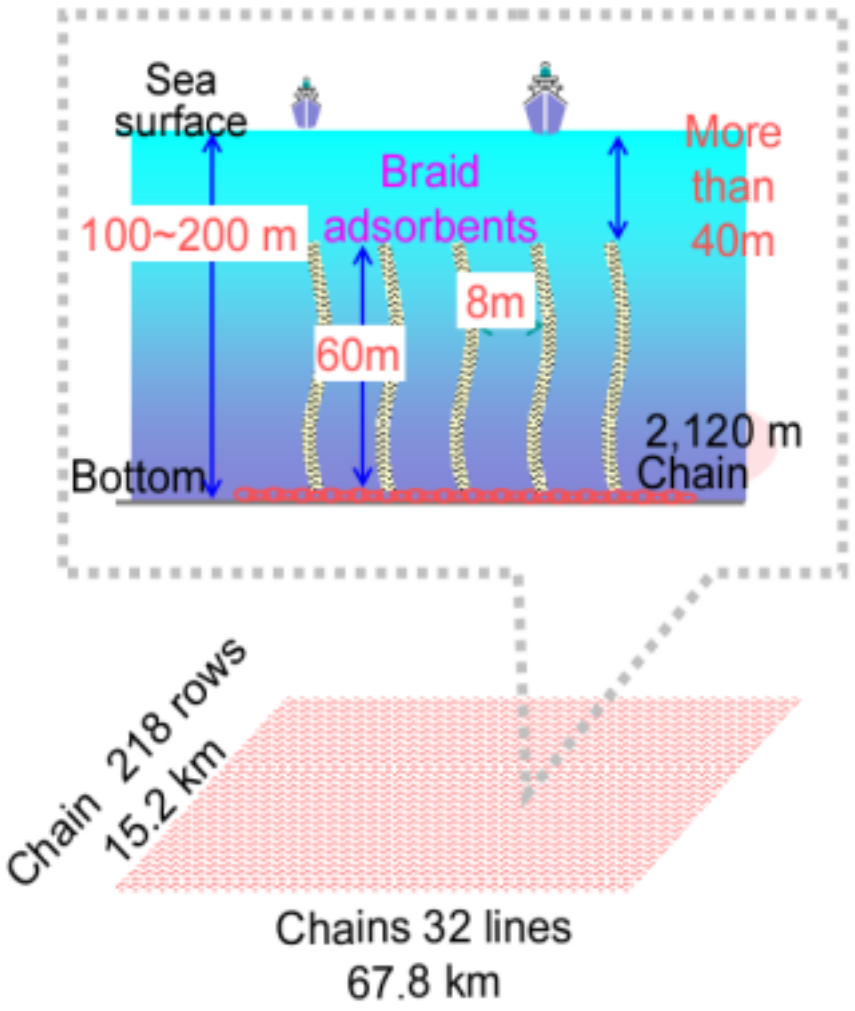
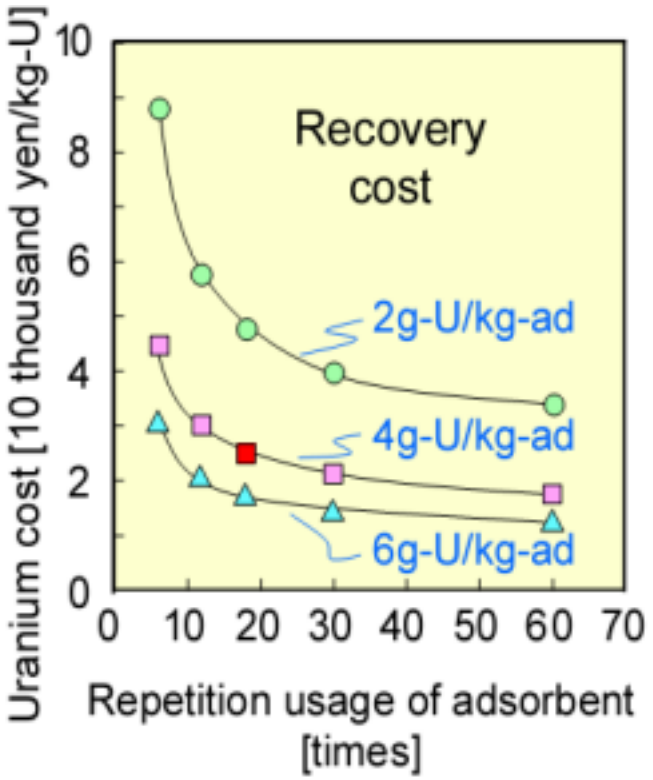
Cost Estimating for 1200 t Uranium in a Year





- Weekly spot price \$48/lb-U_3O_8 at October, 2009 is 12,000 yen/kg-U.
- Promising collection cost is 25,000 yen/kg-U. This price is twice of spot price.

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Thank you