

2-3 Evaluating the Solubility of Radionuclides with Speciation in Groundwater — Development of the Thermodynamic Database for Safety Assessment of Geological Disposal —

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H																	He
2	Li	Be										B	C	N	O	F	Ne	
3	Na	Mg										Al	Si	P	S	Cl	Ar	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			

Red : Elements of interest in JAEA-TDB
Green : TDB developed by the NEA as of 2009

Fig.2-7 Periodic table showing the elements of interest in the JAEA-TDB

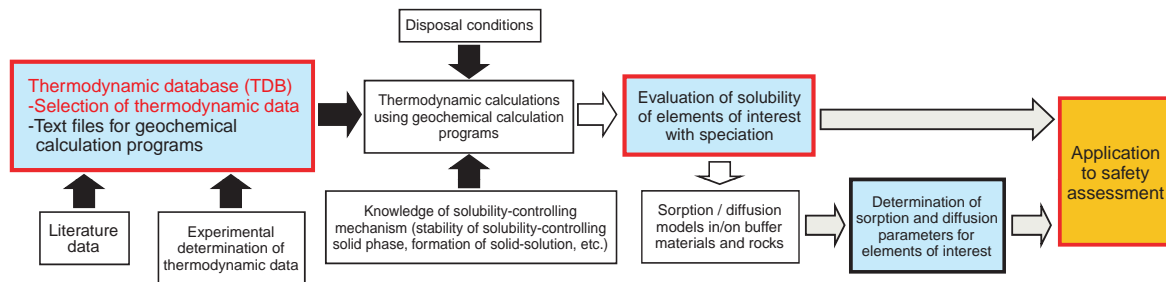


Fig.2-8 Schematic view of the status of the thermodynamic database for safety assessment of geological disposal

The first process of radionuclide release from vitrified waste will be via dissolution of radionuclides into groundwater. The speciation and solubility of radionuclides are fundamental to performing geological disposal safety assessment. Although many studies on radionuclide solubility have been performed, it is not easy to use the solubility data directly, because solubility depends on groundwater compositions that are usually more complex than those in most solubility studies, and thus we need to compile a database which consists of thermodynamic constants for chemical equilibrium calculations.

Development of a thermodynamic database (TDB) is accepted in several countries as well as in Japan. For example, the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development has carried out a TDB project in which we have been participating since 1984, and TDBs for 9 elements had been developed as of 2009.

We developed our TDB (the JAEA-TDB) through reviewing and selecting thermodynamic data based on the

NEA guidelines while enhancing the guidelines applicable to selecting thermodynamic data for the 25 elements shown in Fig.2-7, which are important for geological disposal safety assessment. As a result, we collected 880 items of thermodynamic data respecting the elements of interest for safety assessment, 180 of which pertain to groundwater composition, and 140 of which pertain to geochemical reactions at the mineral/water interface. Furthermore, we confirmed the reliability of the JAEA-TDB through checking internal consistencies from several points of view. Using the JAEA-TDB permits us to evaluate the solubility of radionuclides with speciation, which provides basic information for determining sorption and diffusion parameters; these values are fundamental to performing safety assessment, as shown in Fig.2-8.

JAEA-TDB text files for some geochemical calculation programs, such as PHREEQC, are available on our website (<http://migrationdb.jaea.go.jp/>). We appreciate your access and feedback.

Reference

Kitamura, A. et al., JAEA Thermodynamic Database for Performance Assessment of Geological Disposal of High-Level Radioactive and TRU Wastes, JAEA-Data/Code 2009-024, 2010, 84p.