

0	1	2	3		4	5	6		7
No	Model	Multiple Scales Media ^a	(H) Flow		(T) Thermal Transport ^d	(M) Geo-Mechanics ^e	(C) Chemical Transport ^f		THMC ^g included?
			Phase ^b	Approach ^c			No of Components	Component Automated?	
1	MODFLOW (USGS)	Macro	1P	p-	None	None	N/A	N/A	H
2	GMS-FEMWATER (PSU, Army Corps)	Macro	VF	p-	None	None	1	N/A	HC
3	SEWAT (USGS)	Macro	VF	p-	None	None	1	N/A	HC
4	FEFLOW (DHI)	Macro	VF	p-	Yes	None	MS	N/A	THC
5	AT123D (ORNL, Seview)	Macro	1p	None	None	None	1	N/A	C
6	PHREEQC (USGS)	Macro	none	None	None	None	MCMS	No	C(R)
7	OS3D/GIMRT (PNNL)	Macro, Fracture	1P	p-	Input	No	MCMS	No	C(R)
8	NUFT-C (LLNL)	Macro, Fracture	VF	p-	Yes	No	MCMS	No	THC(R)
9	FEHM (LANL)	Macro, Fracture	3P	p-	Yes	Solid Mech	MS	N/A	THMC
10	PARSSIM1 (UT Texas)	Macro, Fracture	VF	p-	Yes	No	MCMS	No	THC(R)
11	RT3D (Auburn Univ)	Macro	1P	input	Input	No	MS	N/A	C(R)
12	MT3D (Univ Alabama)	Macro	1P	p-	No	No	MS	N/A	C
13	HP1/HP2/HP3 (UC Riverside)	Macro	VF	p-	Yes	No	MS	N/A	THC(R)
14	CrunchFlow (LBNL)	Macro, Fracture	1P	p-	Input	No	MCMS	No	THC(R)
15	MOFAT (U Virginia Tech)	Macro	3p	p-	No	No	No	No	H
16	UTCHEM	Macro	3P	ff-	Yes	Cmp	MCSS	No	THC
17	NAPL (Princeton U)	Macro	3p	ff-	No	No	No	No	H
18	STORM/STOMP/ECKEChem (PNNL)	Macro, Fracture	3P	p-	Yes	No	MCMS	No	THC(R)
19	MULTI-FLO/PFLOTTRAN (LANL)	Macro, Fracture	2P	p-	Yes	No	MCMS	No	THC(R)
20	TOUGH2/TOUGHREACT (LBNL)	Macro, Meso, Fracture	3P	p-	Yes	Solid Mech	MCMS	No	THMC(R)
21	MIN3P (Canada)	Macro, Fracture	VF	p-	Yes	No	MCMS	No	THC(R)
22	CORE2D (Spain)	Macro, Fracture	2P	p-	Yes	No	MCMS	No	THC(R)
23	COMSOL Multiphysics-PHREEQC(SKB)	Macro, Fracture	VF	p-	Yes	GeoMech	MCMS	No	THMC(R)
24	OpenGeoSys (UFZ, Germany)	Macro, Fracture	VF	p-	Yes	Solid Mech	MCMS	No	THMC(R)
25	FRACHem (Switzerland)	Fracture	1p	p-	Yes	None	MCMS	No	THC(R)
26	HYTEC-CHESS-R2D2 (France)	Macro, Fracture	1P	p-	Yes	No	MCMS	No	THC(R)
27	COUPLYS (PNC, Japan)	Macro, Fracture	VF	p-	Yes	Solid Mech	MCMS	No	THMC(R)
28	COWADW123D (PSU)	Macro, Fracture	VF	p-	No	GeoMech	No	No	HM
29	THM (Korea)	Macro, Fracture	2P	p-	Yes	GeoMech	No	No	THM
30	HYDROGEOCHEM (ORNL)	Macro, Fracture	VF	p-	Input	Cmp	MCMS	No	THC(R)
31	MURF-MURT (PSU-ORNL)	Macro, Meso, Micro, Fracture	VF	p-	No	Cmp	MCMS	No	HC(R)
32	HBGC123 (PSU - ORNL)	Macro, Meso, Micro, Fracture	VF	p-	No	Cmp	MCMS	No	C(R)
33	MPS (PSU-UCF)	Macro, Fracture	3P	ff-	No	No	No	No	H
34	HYDROBIOGEOCHEM (PSU-UCF)	Macro, Fracture	3P	Input	Yes	Cmp	MCMS	Yes	THC(R)
35	HYDROGEOCHEM 4.0 5.0 (UCF-ORNL)	Macro, Fracture	VF	p-	Yes	Cmp	MCMS	Yes	THC(R)
36	HGC 4.1 to 4.6 & 5.1 to 5.6 (NCU-TPC)	Macro, Fracture	VF	p-	Yes	Cmp, GeoMech	MCMS	Yes	THC(R),THMC(R)
37	HGC 6.0 to 6.2 & 7.0 to 7.2 (NCU)	Macro, Fracture	MP	ff-	Yes	GeoMech	MCMS	Yes	THMC(R)

^aMacro = Macroscale; Meso = Mesoscale; Micro = Microscale; Fracture = Fracture scale
^b1P = 1 phase; VF = Variably saturated flow; 2P = 2 phases (aqueous, air); 3P = 3 phases (aqueous, air, NAPL); MP = Multiple phase (more than 3 phases)
^cp- = essure-based approach; ff- = fractional flow-based approach; input = not simulated (must obtain flow field from flow models)
^dYes = modelled; no = not included; input = temperature is input parameter
^eCmp = Compressibilities are input, geomechanics not explitly modeled; No = not included; Solid Mech = Solid Mechanics; GeoMech = Geo-Mechanics
^fMCMS = Multiple components-multiple species; MS = Multiple species (No concept of components); MCSS = Multiple Components-single species
^gC(R) = Reaction-based Chemistry

0	1	8							9		10
No	Model	Geochemical Reactions ^h							Numerical Methods ⁱ		GUI and MeshGen
		A/C	A/D	I/E	P/D	Bio	UDA	UDR	ACRT	Transport	
1	MODFLOW (USGS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
2	GMS-FEMWATER (PSU, Army Corps)	No	EQ	No	No	KI	N/A	N/A	N/A	FEM, LE-FEM	Yes
3	SEWAT (USGS)	No	EQ	No	No	KI	N/A	N/A	N/A	FEM	No
4	FEFLOW (DHI)	No	EQ	No	No	KI	N/A	N/A	N/A	FEM	Yes
5	AT123D (ORNL, Seview)	No	EQ	No	No	KI	N/A	N/A	N/A	Analytical	Yes
6	PHREEQC (USGS)	EQ	EQ	EQ	EK	KI	None	All	OS	Mixed Cell	Yes
7	OS3D/GIMRT (PNNL)	EQ	EQ	No	EK	No	None	None	OS, DSA(GIM), SIA	FDM	No
8	NUFT-C (LLNL)	EQ	EQ	EQ	EK	No	None	None	DSA(GIM)	IFDM	No
9	FEHM (LANL)	EQ	EQ	No	EQ	No	None	None	OS	FEM	No
10	PARSSIM1 (UT Texas)	EK	EK	EK	EK	KI	None	None	OS	FDM	No
11	RT3D (Auburn Univ)	EQ	EQ	EQ	KI	KI	None	Bio	OS	FDM	No
12	MT3D (Univ Alabama)	EQ	EQ	EQ	KI	KI	None	Bio	N/A	FDM/FVM	Yes
13	HP1/HP2/HP3 (UC Riverside)	EQ	EQ	EQ	EK	KI	None	All	OS	FEM	Yes
14	CrunchFlow (LBNL)	EQ	EQ	EQ	EK	KI	None	All	OS, DSA(GIM)	FDM/TVD	No
15	MOFAT (U Virginia Tech)	No	No	No	No	No	N/A	N/A	N/A	FEM	No
16	UTCHEM (UT Austin)	No	EQ	No	EK	KI	None	None	N/A	FDM/TVD	No
17	NAPL (Princeton U)	No	No	No	No	No	N/A	N/A	N/A	FEM	No
18	STORM/STOMP/ECKEChem (PNNL)	EQ	EQ	No	KI	No	None	None	OS	FDM/FVM	No
19	MULTI-FLO/PFLOTRAN (LANL)	EQ	EQ	No	KI	No	None	None	OS	FDM/FEM	Yes
20	TOUGH2/TOUGHREACT (LBNL)	EQ	EQ	KI	EK	KI	None	All	OS, SIA	IFDM	Yes
21	MIN3P (Canada)	EQ	EQ	EQ	EK	KI	None	None	SIA	FVM	No
22	CORE2d (Spain)	EQ	EQ	No	KI	No	None	None	SIA	FEM	No
23	COMSOL Multiphysics-PHREEQC (SKB)	EQ	EQ	EQ	EK	No	None	All	OS	FEM	Yes
24	OpenGeoSys (UFZ, Germany)	EQ	EQ	EQ	EK	No	None	All	OS	FEM	Yes
25	FRACHem (Switzerland)	EQ	EQ	EQ	EK	No	None	None	OS	FEM	Yes
26	HYTEC-CHESS-R2D2 (France)	EQ	EQ	EQ	EK	No	None	None	OS, SIA	FVM	Yes
27	COUPLYS (PNC, Japan)	EQ	EQ	EQ	EK	No	None	All	OS	FEM	Yes
28	COWADE123D (PSU)	No	No	No	No	No	None	None	N/A	FEM	No
29	THM (Korea)	No	No	No	No	No	None	None	N/A	FEM	No
30	HYDROGEOCHEM (ORNL)	EK	EK	EK	EK	No	None	None	SIA	FEM	No
31	MURF-MURT (PSU-ORNL)	No	No	No	No	No	None	None	N/A	FEM, LE-FEM	No
32	HBGC123 (PSU - ORNL)	EQ	EQ	EQ	EQ	KI	None	None	SIA	FEM, LE-FEM	No
33	MPS (PSU-UCF)	No	No	No	No	No	None	None	N/A	FEM, LE-FEM	No
34	HYDROBIOGEOCHEM (PSU-UCF)	EK	EK	EK	EK	EK	All	All	OS, PC, PC-OS, SIA	FEM, LE-FEM	No
35	HYDROGEOCHEM 4.0 5.0 (UCF-ORNL)	EK	EK	EK	EK	EK	None	None	OS, PC, PC-OS, SIA	FEM, LE-FEM	No
36	HGC 4.1 to 4.6 & 5.1 to 5.6 (NCU-TPC)	EK	EK	EK	EK	EK	All	All	OS, PC, PC-OS, SIA	FEM, LE-FEM	Yes
37	HGC 6.0 to 6.2 & 7.0 to 7.2 (NCU)	EK	EK	EK	EK	EK	All	All	OS, PC, PC-OS, SIA	FEM, LE-FEM	Yes

^hA/C = Aqueous Complexation; A/D = Adsorption-Desorption; I/E = Ion Exchange; P/D = Precipitation-Dissolution; Bio = Biomediated/Biodegradation;

UDA = Allow User's Defined Algebraic Equations for Equilibrium Reactions; UDR = Allow User's Defined Rate Equations for Kinetic Reactions.

KI = kinetic reaction; EK = Mixed equilibrium and kinetic reaction; No = not modeled; EQ = Equilibrium reaction; None = None is allowed;

BIO = User's defined rates are allowed only for biomediated reactions; All = User's defined rates are allowed for all reactions

ACRT = Approach to Coupled Reaction and Transport; OS = Operator splitting; DSA(GIM) = Direct substitution approach(Global implicit method); PC = Predictor-corrector;

SIA = Sequential iteration approach; FDM = Finite difference method; FVM = Finite volume method; IDFM = Integrated FDM; FEM = Finite element method;

TVD = Total Variation Diminishing; LE-FEM = Lagrangian-Eulerian FEM