

**Software Release Notice
Developed or Modified Software**

1. Software Name: MULTIFLO Software Version: 2.0.1

2. Software Function: Thermal-hydrological-chemical simulation in fractured porous media.

3. Summary of Actions:
 New Software Update to Existing Software Software Retirement

4. Software Development

4a. Software Requirements Description (SRD) Date Approved: 10-31-2000
 4b. Software Development Plan (SDP) Date Approved: 2-27-2004
 4c. Software Change Report (SCR) Nos: SCR 557
 4d. User's Guide Approval Data 8-15-2003
 4e. Enclosed: Copy of Program Title Block Sample Source Code Header Block

Installation Performed by: Scott Painter Date: 3-10-2005

Remarks: clean install from CD

5. Software Installation

5a. Computer Platform(s): PC & SUN 5b. Operating System(s): Windows XP/Solaris 5c. Programming Language(s): Fortran 77 & 90
 5d. Installation Testing: Passed Testing Performed on: 3-10-2005
 Description of Testing Performed: Installed on Gorgon & Tenes
 5e. Archive Copy: Enclosed Not Available, Why:

Installation Performed by:: Scott Painter Date: 3-10-2005
Scott Painter

Remarks:

6. Software Assessment

6a. Acceptance Testing:
 Enclosed Documented in Scientific Notebook No. 282E
 Documented in SCRs (see above) SCR557

6b. Validation Status:
 Full Validation Limited Validation Date of Validation: _____
 Not Validated, Explain: v1.5.2 is validated. Validation in progress

Software Developer: Scott Painter Date: for v2.0.1
Scott Painter 3-10-2005

Remarks:

7. Approval

Manager: S.C.P. Date: 3/10/2005

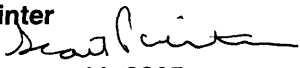
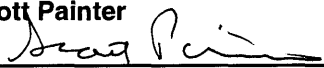
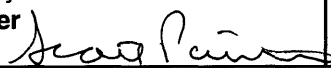
Remarks:

7. QA Verification

SRN Number: 352
 Software Custodian ALBent Date: 3/11/2005

Remarks:

SOFTWARE CHANGE REPORT (SCR)

1. SCR No. (<i>Software Developer Assigns</i>): SCR-557	2. Software Title and Version: Multiflo V2.0	3. Project No: 20.06002.01.214
4. Affected Software Module(s), Description of Problem(s): The following problems have been identified with V2.0. Revised code will be released as V2.0.1. (1) Ionic strength calculation in gem is causing failure for concentrated solutions. Need to introduce limit. Requires change to gem/gameq and gem/gamex (2) boundary conditions not correct in 2-d and 3-d for conduction only runs in metra. Requires one line change in metra/cond. (3) Mole fraction of air in liquid not set properly at boundary for saturated boundaries. Requires change to metra/setbc. (4) Small changes required in metra/updtpsk and metra/updtpvk to improve stability following a phase change. (5) Excessive run times for unstructured grids have been observed. Numerical experimentation demonstrates that reordering of nodes will fix the problem. Need to provide an option for reordering nodes at the solver level. This change will require WATSOLV to be replaced. (6) Monitored nodes not accessed correctly in emip in DCM simulations. Small change to emip.f is required.		
5. Change Requested by: Scott Painter  Date: February 11, 2005	6. Change Authorized by (<i>Software Developer</i>): Scott Painter Date: February 11, 2005	
7. Description of Change(s) or Problem Resolution (<i>If changes not implemented, please justify</i>): All problems corrected. Required change to gem/gameq, gem/gamex, gem/allotgem, gem/read1, metra/cond, metra/setbc, metra/updtpsk, metra/updtpvk, metra/allot, metra/recdat, and metra/emip. Also required WATSOLV to be replaced by fortran 90 module. Corrected code will be released as V2.0.1		
8. Implemented by: Scott Painter 	Date: Various	
9. Description of Acceptance Tests: Ran the same acceptance tests as for V2.0 (see SN282E). All tests ran successfully. Output and input for the acceptance test problems are on the archived disk.		
10. Tested by: Scott Painter 	Date: March 10, 2005	

```
d:\Multiflo\mflo2.0.1>dir metra\*.f metra\*.h gem\*.f gem\*.h *.f
Volume in drive D is Data
Volume Serial Number is 549A-09EE
```

Directory of d:\Multiflo\mflo2.0.1\metra

02/21/2005	04:29	PM	17,203	accm.f
03/08/2005	11:17	AM	13,935	allot.f
02/21/2005	04:29	PM	31,193	bcond.f
02/21/2005	04:29	PM	8,095	blkdtmet.f
02/21/2005	04:29	PM	32,727	coefs.f
03/07/2005	01:42	PM	21,733	cond.f
02/21/2005	04:29	PM	18,100	dtstep.f
02/21/2005	04:29	PM	21,410	ecmtbl.f
03/08/2005	02:00	PM	23,805	emip.f
02/21/2005	04:29	PM	18,328	equil.f
02/21/2005	04:29	PM	12,049	griddat.f
02/21/2005	04:29	PM	55,396	init.f
02/21/2005	04:29	PM	15,956	inpi.f
02/21/2005	04:29	PM	52,493	inpmetra.f
02/21/2005	04:29	PM	22,823	inpwells.f
02/21/2005	04:29	PM	22,782	iter.f
02/22/2005	09:27	AM	27,748	mainmtra.f
02/21/2005	04:29	PM	12,907	openfls.f
02/21/2005	04:29	PM	36,182	outmetra.f
02/21/2005	04:29	PM	8,632	outwells.f
02/21/2005	04:29	PM	29,557	pckr.f
02/21/2005	04:29	PM	53,450	plots.f
02/21/2005	04:29	PM	20,068	pproc.f
02/21/2005	04:29	PM	9,354	prints.f
02/21/2005	04:29	PM	27,627	pvt.f
02/21/2005	04:29	PM	19,446	pvtfunc.f
02/21/2005	04:29	PM	29,376	pvtth2o.f
02/21/2005	04:29	PM	26,420	pvtvp.f
03/07/2005	04:39	PM	69,699	recdat.f
03/07/2005	01:46	PM	13,530	setbc.f
02/21/2005	04:29	PM	16,424	slv1p.f
03/07/2005	01:39	PM	10,350	solve.f
02/21/2005	04:29	PM	10,689	source.f
02/21/2005	04:29	PM	13,587	thomas.f
02/21/2005	04:29	PM	10,194	trans.f
02/21/2005	04:29	PM	8,995	update.f
03/07/2005	01:48	PM	16,721	updtpsk.f
03/07/2005	01:48	PM	17,562	updtvpk.f
02/21/2005	04:29	PM	30,602	util.f
02/21/2005	04:29	PM	25,820	wells.f

Directory of d:\Multiflo\mflo2.0.1\metra

02/21/2005	04:29	PM	2,541	add.h
02/21/2005	04:29	PM	5,002	com.h
02/21/2005	04:29	PM	503	frfmt.h
02/21/2005	04:29	PM	179	impl.h
02/21/2005	04:29	PM	2,641	metragem.h
02/21/2005	04:29	PM	2,278	para1.h
03/08/2005	10:18	AM	2,797	paramtrs.h
02/21/2005	04:29	PM	1,085	pckr.h
02/21/2005	04:29	PM	565	pvtfunc.h
02/21/2005	04:29	PM	916	pvttbl.h
02/21/2005	04:29	PM	1,698	scalars.h
03/07/2005	01:53	PM	2,162	title.h
02/21/2005	04:29	PM	266	units.h
02/21/2005	04:29	PM	800	wells.h

54 File(s)

956,401 bytes

Directory of d:\Multiflo\mflo2.0.1\gem

03/08/2005	02:35	PM	18,848	allotgem.f
03/01/2005	02:13	PM	7,080	blkdtgem.f
03/01/2005	02:13	PM	15,542	bndcond.f
03/01/2005	02:13	PM	15,482	calcpsi.f
03/01/2005	02:13	PM	24,264	coefimp.f
03/01/2005	02:13	PM	24,739	coeftvd.f
03/01/2005	02:13	PM	13,174	dataall.f
03/01/2005	02:13	PM	44,989	database.f
03/01/2005	02:13	PM	15,646	derives.f
03/01/2005	02:13	PM	11,434	elechem.f
03/01/2005	02:13	PM	11,122	eqjac.f
03/01/2005	02:13	PM	39,442	eqlib.f
03/01/2005	02:13	PM	12,108	egres.f
03/01/2005	02:13	PM	4,419	flogk.f
03/07/2005	01:50	PM	9,938	gameq.f
03/07/2005	01:51	PM	10,453	gamextd.f
03/01/2005	02:13	PM	23,231	graph1d.f
03/01/2005	02:13	PM	29,790	graph2d.f
03/01/2005	02:13	PM	22,176	graph3d.f
03/01/2005	02:13	PM	7,493	gunits.f
03/04/2005	04:51	PM	24,005	implicit.f
03/01/2005	02:13	PM	31,276	imret.f
03/01/2005	02:13	PM	49,595	initgem.f
03/01/2005	02:13	PM	10,142	interp.f
03/01/2005	02:13	PM	9,403	ionexc.f
03/01/2005	02:13	PM	24,904	kinrxnaq.f
03/01/2005	02:13	PM	16,856	kinrxns.f
03/01/2005	02:13	PM	10,078	linmonod.f
03/01/2005	02:13	PM	12,284	luslv.f
03/01/2005	02:13	PM	24,354	maingem.f
03/01/2005	02:13	PM	9,262	massbal.f
03/01/2005	02:13	PM	14,316	masstran.f
03/04/2005	04:54	PM	67,588	opsplit.f
03/01/2005	02:13	PM	57,144	outgem.f
03/01/2005	02:13	PM	8,860	pecletnr.f
03/01/2005	02:13	PM	17,553	pprcgem.f
03/08/2005	12:52	PM	48,488	read1.f
03/01/2005	02:13	PM	55,443	read2.f
03/01/2005	02:13	PM	10,702	setbcon.f
03/01/2005	02:13	PM	7,675	setconn.f
03/01/2005	02:13	PM	7,558	solprd.f
03/01/2005	02:13	PM	6,897	solprodt.f
03/01/2005	02:13	PM	23,242	solvel.f
03/01/2005	02:13	PM	10,700	speciate.f
03/01/2005	02:13	PM	3,335	srcgem.f
03/01/2005	02:13	PM	16,061	startup.f
03/01/2005	02:13	PM	16,150	stdyst.f
03/01/2005	02:13	PM	10,690	stepgem.f
03/01/2005	02:13	PM	8,044	textab.f
03/01/2005	02:13	PM	11,580	transd.f
03/01/2005	02:13	PM	8,808	updtgem.f
03/01/2005	02:13	PM	30,540	util.f
03/01/2005	02:13	PM	6,049	zonek.f

Directory of d:\Multiflo\mflo2.0.1\gem

03/01/2005	02:13	PM	2,005	addgem.h
03/01/2005	02:13	PM	4,821	comgem.h
03/01/2005	02:13	PM	289	comprs.h
03/01/2005	02:13	PM	714	cxkin.h
03/01/2005	02:13	PM	142	debye.h

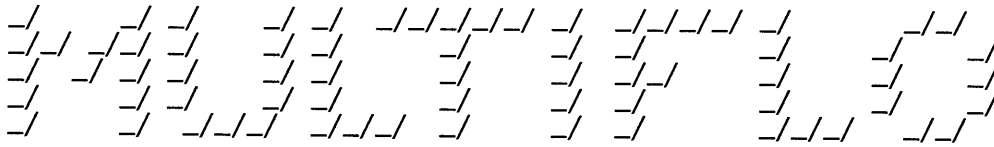
03/01/2005	02:13 PM	310	fields.h
03/01/2005	02:13 PM	503	frfmt.h
03/01/2005	02:13 PM	72	gas.h
03/01/2005	02:13 PM	114	gmfw.t.h
03/01/2005	02:13 PM	179	impl.h
03/01/2005	02:13 PM	210	iounits.h
03/01/2005	02:13 PM	716	kinetic.h
03/01/2005	02:13 PM	2,641	metragem.h
03/01/2005	02:13 PM	77	minr1.h
03/01/2005	02:13 PM	532	ofiles.h
03/08/2005	10:18 AM	2,797	paramtrs.h
03/01/2005	02:13 PM	1,486	scalgem.h
03/01/2005	02:13 PM	271	scratch.h
03/01/2005	02:13 PM	354	surfkin.h
03/01/2005	02:13 PM	300	tdconst.h
03/07/2005	01:53 PM	2,214	title.h
03/01/2005	02:13 PM	266	units.h
		75 File(s)	1,051,965 bytes

Directory of d:\Multiflo\mflo2.0.1

03/01/2005	05:52 PM	21,109	gem.f
03/07/2005	01:54 PM	28,680	mainmlti.f
03/02/2005	10:33 AM	24,337	metra.f
		3 File(s)	74,126 bytes
		0 Dir(s)	37,725,687,808 bytes free

d:\Multiflo\mflo2.0.1>

This file was created on: Thu Mar 10 11:07:12 2005



Developed for the U.S. NRC

VERSION 2.0.1

March 2005

MULTIPHASE-MULTICOMPONENT CHEMICAL TRANSPORT MODEL

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dcm demonstration with YM parameters

c*file cond.f

c Program Name: MULTIFLO/METRA
c File/Subroutine Name: cond.f/cond.f qcond.f

c Release Date: March 2005
c Release Version: 2.0.1
c Client Name: USNRC
c Client Contact: David Brooks (301-415-6597)
c Contract Number: NRC 02-97-009
c CNWRA Contact: Scott Painter (210-522-3348)
c Center for Nuclear Waste Regulatory Analyses
c San Antonio, Texas 78238-5166
c spainter@swri.edu

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c VERSION/REVISION HISTORY

c \$Id\$
c \$Log\$

Date	Author(s)	Comments/Modifications
February 97	Mohan S. Seth	Initial Implementation
May 98	Peter C. Lichtner	
July 01-SCR351:	Mohan s seth	revised for unstructured grid
	-do-	revised for boundary block storage assignment.
February 2005	Scott Painter	SCR-557 Item 2. Boundary conditions fixed for 2-d and 3-d

CC

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CC

c PURPOSE:

c This routine is the main computational module for pure heat
c conduction problems. It calls all the related routines and
c a time step is completed upon return from this routine.

c It is not designed for dcm formulations.

CC

c INTERFACING ARGUMENTS:

c Variable name	Type	Description
c =====	=====	=====
c c	Array(nb), Real*8	diagonal matrix elements
c cc	Array(nb*nrow) Real*8	total no of elements in the jacobian
c r	Array(nb), Real*8	residual and solution vector
c dsol	Array(nb), Real*8	temporary used for solution
c txc	Array(nconn), Real*8	thermal transmissibility.
c area	Array (nconn), Real*8	block surface area for all connections
c ncdiag	Array (nb), Real*8	diagonal element no in the jacobian for all rows
c maxnc	scalar, Integer*4	max no of elements or grid blocks
c ndcon	Array (nb*nrow), Real*8	array defining node connection
c aa	Array(maxaa), Real*8	main work array
c nrow	scalar, Integer*4	max no of elements in a row

c -----
c Externals
c =====

c NONE

CC

c INTERFACING ROUTINES

c Calling routines
c =====

c metra.f
c (mainmetra.f for standalone metra)

c Called routines	Function
c =====	=====
c cputim.f	calc cpu time
c qcond.f	sets source/sinks in the jacoby for pure ehat conduction
c solve.f	solves the matrix equations Ax = r

CC

c INCLUDE FILES

c Name	Description
c =====	=====
c 'add.h'	addresses (pointers) for dynamic memory allocation.
c 'impl.h'	Declares real variables to real*8 and sets frequently used constants in common.
c 'com.h'	arrays in common
c 'metragem.h'	variables common to both metra and gem codes.
c 'paramtrs.h'	sets dimension limits for all variables.
c 'scalars.h'	scalars in common
c 'units.h'	input/output unit variables

CC

c SYSTEM LIBRARY ROUTINES

c Name	Description
c =====	=====


```
c      abs                absolute value of real*8 variables
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

```
c      OUTPUT UNIT(s)
```

```
c      Unit Name(Number)      file name          Description
```

```
c      ifbug (56)             lfn_bug           debug output
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

```
c      REFERENCES
```

```
c      None
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

```
c      PROGRAM FLOW AND BRIEF DESCRIPTION
```

```
c      solves heat conduction eqn.:
```

```
c       $\text{div}(k).\text{grad}(T) + qh = \text{rho}.c.dT/dt$ 
```

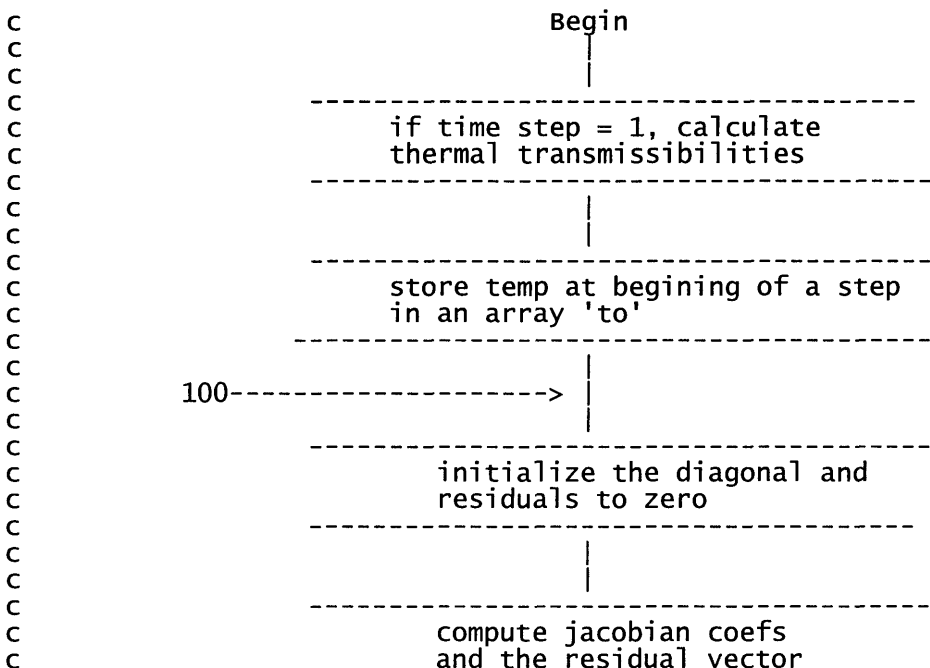
```
c      subject to arbitrary initial condition, and
```

```
c      Newumann and Dirichlet conditions including boundary temp and
c      radiation heat flux as a function of time.
```

```
c      radiation boundary flux =  $\text{sigma} \cdot \text{emissivity} \cdot (T_{\text{abs}}(i)**4 - T_{\text{abs}}(i-1)**4)$ 
```

```
c      Linear problem for constant T, and non-linear for radiation BC.
```

```
c      Formulated in residual form with iterative solution of change in
c      temperature over an iteration. Only one iteration is required for
c      problems with no radiation bc.
```




```
save dtmpmaxo
```

```
=====
```

```
call cputim(0)
```

```
if(itime.le.1) then
```

```
c...sets max iterations to 1 for a problem with no radiation bc  
c otherwise it is set to 7
```

```
  i1 = 1  
  do m = 1,nblkbc  
    if(cradbc(m).gt.zero) i1 = 7  
  end do  
  newtnmx = i1
```

```
c... computes thermal transmissibilities  
c This remains constant for the run and calculated only for the  
c first time step.
```

```
  do nc = 1,nconn  
    m1 = nd1(nc)  
    m2 = nd2(nc)  
    n2 = ithrm(m2)  
    n1 = ithrm(m1)  
    ck2 = ckdry(n2)  
    ck1 = ckdry(n1)  
    u1 = ck1*ck2  
    u2 = ck1*dist2(nc)+ck2*dist1(nc)  
    if(u1*u2.gt.zero) then  
      txc(nc) = u1*area(nc)/u2  
    else  
      txc(nc) = zero  
    endif  
  end do  
end if
```

```
  newton = 0  
  dtmpmax = zero
```

```
c... save the initial temp in to-array
```

```
  i1 = ito-1  
  do m = 1,nb  
cms   to(m) = tmpr(m)  
       aa(i1+m) = tmpr(m)  
  end do
```

```
100 newton = newton+1  
    dtmpmaxo = dtmpmax
```

```
=====
```

```
c... set the jacobian coefficient matrix and residual vector
```

```
=====
```

```
c...      augment the residual and diagonal for accm term
```

```
  i1 = ito-1  
  do m = 1,nb  
    u1 = vbcpr(m)*udt  
    c(m) = -u1  
cms   r(m) = u1*(tmpr(m)-to(m))  
       r(m) = u1*(tmpr(m)-aa(i1+m))  
  enddo
```

c*file mainmlti.f

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```

c Program Name:          MULTIFLO
c File/Program Name:    mainmlti.f/MULTIFLO
c Other modules:        block data metragem
c                        cputim.f
c                        seconds.f
c                        lnblnk.f
c                        convert.f
c                        frfmt.f
c Release Date:         March 2005
c Release Version:      2.0.1
c Client Name:          USNRC
c Client Office:        Division High Level Waste Repository Safety
c Client Contact:       David Brooks (301-415-7284)
c Contract Number:      NRC 02-02-012
c CNWRA Contact:        Scott Painter (210-522-3348)
c                        Center for Nuclear Waste Regulatory Analyses
c                        San Antonio, Texas 78238-5166
c                        spainter@swri.edu

```

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c VERSION/REVISION HISTORY

c \$Id\$
c \$Log\$

Date	Author(s)	Comments/Modifications
April 97	Peter C. Lichtner Mohan S. Seth	Initial Implementation
May 98		Beta Release
February 2000	Peter C. Lichtner Mohan S. Seth Scott Painter	1.2 Release
May 2000		V1.2.1 Minor Bug fixes
August 2000		V1.2.2 Fix bug related to water density calculation and phase change test
December 2000		V1.2.3 Fix bug related to dryout in GEM. Also change surface area update in GEM, which was bypassed for secondary minerals. Minor fix to printing errors.
July 2001		V1.5 Section 5,7,8 of V2.0 SRD Also assorted minor fixes
June 2002		SCR351
July 2002	Scott Painter	SCR406
March 2004		V2.0
March 2005	Scott Painter	V2.0.1 see SCR557

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C FAILURE OF THE PROGRAM TO OPERATE WITH OTHER PROGRAMS) THE PROGRAM,
C EVEN IF YOU HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES,
C OR FOR ANY CLAIM BY ANY OTHER PARTY.

CC

C PURPOSE:

c This routine is the main program for the MULTIFLO driver which
c couples METRA and GEM.

CC

C INTERFACING ARGUMENTS:

c Variable name	Type	Description
c =====	=====	=====
c none		

C-----

C Externals
C =====

c none

CC

C INTERFACING ROUTINES

c Calling routines
c =====

c none

c Called routines	Function
c =====	=====

c gunits.f	-Command line interface for gem.
c metra.f	-Driver for METRA (Similar to stand-alone main program.
c gem.f	-Driver for GEM (Similar to stand-alone main program.
c cputim.f	-Routine to measure cpu time.

CC

C INCLUDE FILES

c Name	Description
c =====	=====

```

C      include files common to metra and gem
C      met/impl.h          -Declares real variables to real*8 and sets
C                          frequently used constants in common.
C      met/metragem.h     -Variables which are common to both metra and
C                          gem codes.
C
C      met/paramtrs.h     -Sets dimension limits for all variables.
C
C      gem include files
C      gem/addgem.h       -Sets pointers for dynamic memory.
C      gem/scalgem.h      -Scalars in common.
C      gem/comgem.h       -General common block.
C      gem/iounits.h      -I/O unit numbers.

```

CC

C SYSTEM LIBRARY ROUTINES

```

C      Name                Description
C      ====                =====

```

```

C      etime, fdate()

```

CC

C OUTPUT UNIT(s)

```

C      Unit Name(Number)      Description          file name
C      iunit2 (8)             normal run output    masout

```

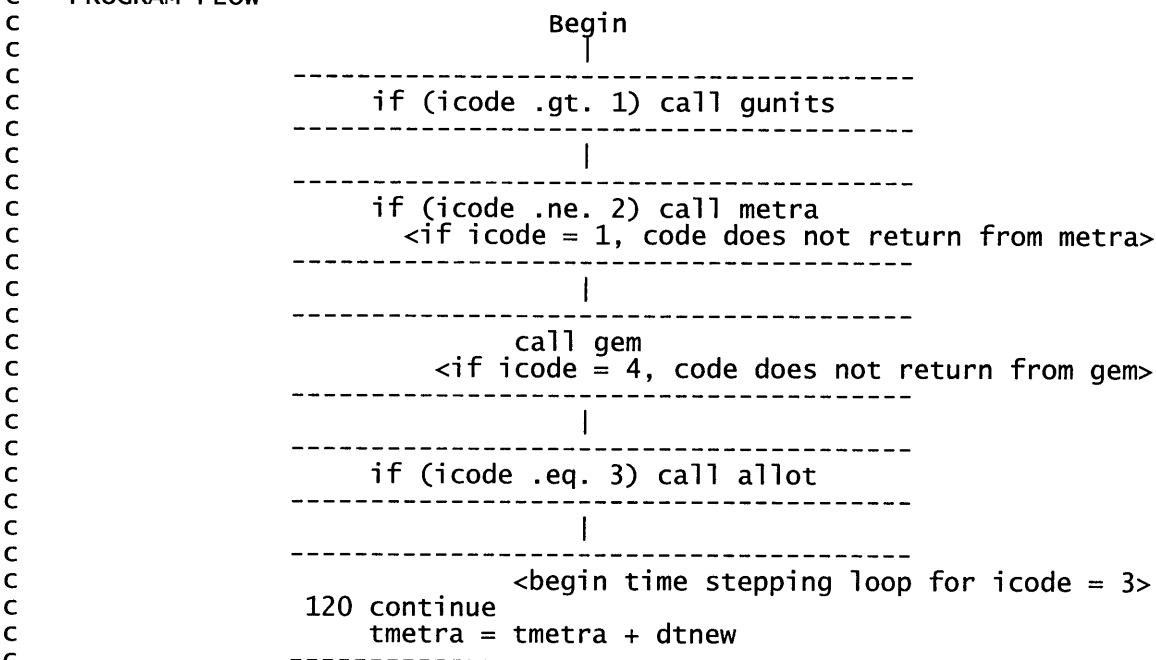
CC

C REFERENCES

C none

CC

C PROGRAM FLOW



```

C
C
C      |
C      -----
C      call metra
C      -----
C      |
C      -----
C      call gem
C      -----
C      |
C      -----
C      if (nprint .gt. nprin) goto 190
C      -----
C      |
C      -----
C      goto 120
C      -----
C      |
C      -----
C      190 continue
C      -----
C      |
C      -----
C      STOP
C      -----
C

```

program multiflo

C*****

C multiflo is a multi-component-multi-phase chemical transport
C model for hydrothermal fluids reacting with minerals. this version
C of multiflo was completed March 2005

C authors ... peter c. lichtner, mohan seth, and scott painter
C cnwra
C southwest research institute
C san antonio, texas

C description ... multiflo simulates heat transport, flow and
C solute transport in variably saturated
C fractured porous media.
C chemical reactions incorporated in the code
C include aqueous complexation, redox reactions,
C precipitation/dissolution of minerals and ion
C exchange. provision is included for both
C reversible and irreversible reactions of minerals.

C main program:
C mainmlti.f

C subroutines:

C	GEM			
C	allotgem.f	difoft.f	gridld.f	mastrnos.f
C	blkdtgem.f	eqjac.f	gunits.f	maxchg.f
C	bndcond.f	eqlib.f	hybrid.f	mltpsiex.f
C	cehyliq.f	eqres.f	initgem.f	modbnd.f
C	cehytwph.f	explicit.f	initrate.f	mprove.f
C	cetvdlq.f	fit.f	interpf.f	opspltex.f
C	cetvdtwp.f	fkinet.f	ionexc.f	opspltgl.f
C	cexact.f	flogk.f	kinrxn.f	opspltim.f
C	cgasos.f	fun.f	output1.f	unitconv.f
C	cihytwph.f	gameq.f	kinrxnex.f	output2.f
				updtgem.f

```
c cliqos.f      gamextd.f      lubksb.f      path.f      watsolv.f
c coefrxn.f    ghostpsi.f    ludcmp.f      pecletnr.f  zonek.f
c coshlyiq.f   graph1d.f     maingem.f     psat.f
c dataall.f    graph2d.f     massbal.f     readat.f
c database.f   graph3d.f     mastrnex.f    solprd.f
c density.f    grid.f        mastrnim.f    solprodt.f
```

```
c      include files
c addgem.h    fields.h      iounits.h     ofiles.h     surfkin.h
c comgem.h    frfmt.h      kinetic.h     paramtrs.h   tempfld.h
c cxkin.h     gas.h        metragem.h    scalgem.h    velsat.h
c debye.h     impl.h       minr1.h       scratch.h    watsolv.h
```

```
C      THERMODYNAMIC DATABASE
C      ms25.r16
C      mstemp.r16
```

```
C      METRA
```

```
c      subroutines
c accm.f      debug.f      mainmetra.f   pvth2o.f     trans.f
c accmvp.f    dtstep.f    misc.f        pvtvp.f     update.f
c allot.f     ecmtbl.f    openfls.f    recdat.f    updtpsk.f
c bcond.f     emip.f      outmetra.f    rstart.f    updtpvk.f
c blkdtmet.f  equil.f     pckr.f        setbc.f     watsolv.f
c coefs.f     griddat.f   plots.f       slvliq.f
c coefsvp.f   init.f      prints.f      solve.f
c cond.f      inpmetra.f  pvt.f         source.f
c d4gaus.f    iter.f      pvtfunc.f    thomas.f
```

```
c      include files
c add.h       frfmt.h      metragem.h    pckr.h       pvttbl.h     units.h
c com.h       impl.h       paramtrs.h    pvtfunc.h    scalars.h    watsolv.h
```

```
C=====
```