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% This script uses 'Definitions_uncoupled.m' and
'Equations_uncoupled.m' to
% then solve for the time dependent solution of sulfur and carbon
in the whole ocean
% based on equations that have:
% 1. CaCO3 output based on a first order rate law with DIC
% 2. The Org C output value based on DIC-Corg fractionation with
modernish
% values of 27 permil
% 3. The reduced sulfur output is tied to the organic carbon
output via
% the classic Berner ratio of 1-3 wt %
% 4. The oxidized sulfur output (evaporites) is a constant (steady
state solution based % on a first order
% rate law with [S04].)
% 5. using foram carbonate +1permil as the overall ocean d13C.

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% Set the initial conditions

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Definitions_uncoupled;

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% Set the initial condition of the ecf to be identical to seawater

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c0 = zeros(4,1);

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% Sulfur Initial Conditions %%%%%%%%%%

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% Initial isotope ratio of ocean in permil
RatioS_0 = ((delS_0./1000)+1)*stdratio_S; % Initial isotope ratio
in mol_34/mol_32
% Initial total [S04] in ocean in mol/m^3
% Stot_0 = 2.8;
% c0(S_32) = Stot_0./(1+RatioS_0); % Initial S_32 [S04] of
ocean in mol/m^3
% c0(S_34) = RatioS_0.*c0(S_32); % Initial S-34 S04 conc of ocean

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% Carbon Initial Conditions %%%%%%%%%%

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delC_0 = del_C_foram_start + d13C_offset; %
Initial isotope ratio of ocean in permil
RatioC_0 = ((delC_0./1000)+1)*stdratio_C; % Initial isotope ratio
in mol_34/mol_32
Ctot_0 = dic.*1029; % Initial total [DIC] in ocean in mol/
m^3
c0(C_12) = Ctot_0./(1+RatioC_0); % Initial C-12 [DIC] of
ocean in mol/m^3
c0(C_13) = RatioC_0.*c0(C_12); % Initial C-13 DIC conc of ocean

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% Now start the looping for concentration and sulfur

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flux in      %%%%%%%%%%

ExpNum = 0;
% Variable for counting the number of total experiments run
count1 = 0;

global Stot_0 F_32_in del_in_S;

% for k = 2;
%   CS_red_ratio = (32./12).*k;
%   count1 = count1 +1;
%
%   burial_ratio(count1) = CS_red_ratio;

count2 = 0;

for j = 4;

    Stot_0 = j*2.8;
    count2 = count2 +1;
    sulfur_original(count2) = Stot_0;
    c0(S_32) = Stot_0./(1+RatioS_0);          % Initial S_32 [S04] of
ocean in mol/m^3
    c0(S_34) = RatioS_0.*c0(S_32);          % Initial S-34 S04 conc of
ocean

    count3 = 0;

    for g=4;

        del_in_S = g;
        count3 = count3 +1;

        delS_in(count3) = del_in_S;
count4 = 0;

        for i =3.5;

            F_32_in = 1e12.*i;
% Loop for the S0 Mix value
            count4 = count4 +1;
            ExpNum = ExpNum +1;
            sulfur_in(count4) = F_32_in;

            F_34_in = ((del_in_S./1000)+1)*stdratio_S.*F_32_in;
            % eps_S_red = ((del_in_S - delS_0).*(F_32_in+ F_34_in))./
            ((F_C12_red_start./CS_red_ratio)+F_C12_red_start./
            CS_red_ratio.*(((delS_0-30)./1000)+1).*stdratio_S);
            % k_evapnew = (F_32_in + F_34_in - F_C12_red_start./

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CS_red_ratio = F_C12_red_start./CS_red_ratio.*(((delS_0+eps_0)./  
1000)+1).*stdratio_S)./(Stot_0.*VolOcean);
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c=ode15s(@(t,c) Equations_uncoupled(t,c),[0:3.85e5: 76e6],c0);
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ConcMatrix = c.y;
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    Result_uncoupled_Fin3(ExpNum).time = c.x;  
    Result_uncoupled_Fin3(ExpNum).Stot_0 = Stot_0;  
    Result_uncoupled_Fin3(ExpNum).F_32_in = F_32_in;  
    %Result_CS_uncoupled_smo(ExpNum).CS_red_ratio =  
CS_red_ratio;  
    Result_uncoupled_Fin3(ExpNum).del_in_S = del_in_S;  
    Result_uncoupled_Fin3(ExpNum).S32 = c.y(1,:);  
    Result_uncoupled_Fin3(ExpNum).S34 = c.y(2,:);  
    Result_uncoupled_Fin3(ExpNum).C12 = c.y(3,:);  
    Result_uncoupled_Fin3(ExpNum).C13 = c.y(4,:);  
    Result_uncoupled_Fin3(ExpNum).Sconc = c.y(1,:) + c.y(2,:);  
    Result_uncoupled_Fin3(ExpNum).S_3432 = c.y(2,:)./c.y(1,:);  
    Result_uncoupled_Fin3(ExpNum).del_34 = ((c.y(2,:)./  
c.y(1,:))./stdratio_S-1).*1000;  
    %Result_CS_eps(ExpNum).del_pyr = (((c.y(2,:)./c.y(1,:))./  
stdratio_S-1).*1000 + eps_S_red);  
    Result_uncoupled_Fin3(ExpNum).DIC_conc = c.y(3,:) +  
c.y(4,:);  
    Result_uncoupled_Fin3(ExpNum).C_1312 = c.y(4,:)./c.y(3,:);  
    Result_uncoupled_Fin3(ExpNum).del_13 = ((c.y(4,:)./  
c.y(3,:))./stdratio_C-1).*1000;  
    Result_uncoupled_Fin3(ExpNum).del_13foram = (((c.y(4,:)./  
c.y(3,:))./stdratio_C-1).*1000)-d13C_offset;  
    %Result_CS_uncoupled_smo(ExpNum).eps_S_red = eps_S_red;
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    end
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end
```

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end
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%end
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save Result_uncoupled_Fin3;
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%
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```
% time = c.x;
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%
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```
% DIC_conc = c.y(3,:) + c.y(4,:);
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% C_1312 = c.y(4,:)./c.y(3,:);
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% del_13 = (C_1312./stdratio_C-1).*1000;
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%
% S04_conc = c.y(1,:) + c.y(2,:);
% S_3432 = c.y(2,:)./c.y(1,:);
% del_34 = (S_3432./stdratio_S-1).*1000;
% del_pyr = (del_34 + eps_S_red);
%
%
%
% figure(1)
% subplot(1,3,1)
% plot(log10(time),S04_conc , 'o')
% ylabel('[S04] (mol/m^3)')
% xlabel('log years')
% subplot(1,3,2)
% plot(log10(time), del_34, '.')
% ylabel('del 34S')
% xlabel('log years')
% subplot (1,3,3)
% plot (log10(time), del_pyr, 'x')
% ylabel('del 34S pyrite')
% xlabel ('log years')
%
% DIC_conc = c.y(3,:) + c.y(4,:);
% C_1312 = c.y(4,:)./c.y(3,:);
% del_13 = (C_1312./stdratio_C-1).*1000;
%
% figure(2)
% subplot(1,2,1)
% plot(log10(time),DIC_conc , 'o')
% ylabel('[DIC] (mol/m^3)')
% xlabel('years')
% subplot(1,2,2)
% plot(log10(time), del_13, '.')
% ylabel('del 13C')
% xlabel('years')
%
%
%
%
% ResTime = c.y(1,end).*VolOcean./F_32_in

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