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%
%
%
clear all
%
% close figures
%
close('all')
%
% Stress effects on AvA
% Lyr-Spekk_Melke. acoustic properties - 6506/12-1 - Avereage values
%
vp1 = 3396.2;
vs1 = 1778.1;
rho1 = 2463.6;
vpvs1 = vp1/vs1
eps1 = 0;
del1 = 0;
gam1 = 0;
%
% Garn sand acoustic properties - 6506/12-1 - Avereage values
%
vp2 = 4565;
vs2 = 2808.4; %2651.1; % 2718.6; Mudrock
rho2 = 2416.4;
vpvs2 = vp2/vs2
eps2 = 0;
del2 = 0;
gam2 = 0;

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vpvs1 =

    1.9100

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vpvs2 =

    1.6255

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dd_2_5 = (rho2 - rho1)./((rho1 + rho2)/2);
dvp_2_5 = (vp2 - vp1)./((vp1 + vp2)/2);
dvs_2_5 = (vs2 - vs1)./((vs1 + vs2)/2);

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A_2_5 = 0.5*(dd_2_5 + dvp_2_5);
B_2_5 = 0.5*dvp_2_5 - 2*(((1/vpvs1 + 1/vpvs2)/2).^2)*(dd_2_5 + 2*dvs_2_5);
%
% Lyr Fm. acoustic properties - 6506/12-1 - Avereage values
%
vp3 = 3261.6;
vs3 = 1707.6;
rho3 = 2558.8;
vpvs3 = vp3/vs3
eps3 = 0;

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del3 = 0;
gam3 = 0;
%
% Garn sand acoustic properties - 6506/12-1 - Avereage values
%
vp4 = 4565;
vs4 = 2808.4;
rho4 = 2416.4;
vpvs4 = vp4/vs4
eps4 = 0;
del4 = 0;
gam4 = 0;

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```

vpvs3 =

    1.9100

vpvs4 =

    1.6255

```

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dd_12_1 = (rho4 - rho3)./(rho3 + rho4)/2);
dvp_12_1 = (vp4 - vp3)./(vp3 + vp4)/2);
dvs_12_1 = (vs4 - vs3)./(vs3 + vs4)/2);

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A_12_1 = 0.5*(dd_12_1 + dvp_12_1);
B_12_1 = 0.5*dvp_12_1 - 2*((1/vpvs3 + 1/vpvs4)/2).^2)*(dd_12_1 + 2*dvs_12_1);
% %
% Angle of incience
%
anginc = [0:0.001:45]';
incwav = 1;
irfwav = 1;
ipol = 0;
%
%
%
Rpp2=zoeppritz(rho1,vp1,vs1,rho2,vp2,vs2,incwav,irfwav,ipol,anginc);
%
%
%
Rpp3=zoeppritz(rho3,vp3,vs3,rho4,vp4,vs4,incwav,irfwav,ipol,anginc);

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P_diff = [0:60000:60000000]';
vp_EP = 5.77 - 6.94*(0.15) - 1.73*(sqrt(0.05)) + 0.446*(P_diff/1e8 - 1.0*exp(-16.7*P_diff/1e8));
vs_EP = 3.72 - 4.94*(0.15) - 1.57*(sqrt(0.05)) + 0.361*(P_diff/1e8 - 1.0*exp(-16.7*P_diff/1e8));

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dVs_dPe = 0.361.*(1 + 16.7*exp(-16.7*(P_diff/1e8)));
dVp_dPe = 0.446.*(1 + 16.7*exp(-16.7*(P_diff/1e8)));

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vp_ob = vp_EP.*0 + vp3;
vs_ob = vs_EP.*0 + vs3;
rhob_ob = vp_EP.*0 + rho3;
%
rhob_EP = vp_EP.*0 + rho4;

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dd_EP = (rhob_EP - rhob_ob)./((rhob_EP + rhob_ob)/2);
dvp_EP = (vp_EP*1e3 - vp_ob)./((vp_EP*1e3 + vp_ob)/2); % Hastigheter i m/s
dvs_EP = (vs_EP*1e3 - vs_ob)./((vs_EP*1e3 + vs_ob)/2);

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vpvs_ob = vp_ob./vs_ob;
vpvs_EP = vp_EP./vs_EP;

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A_EP = (0.5)*(dd_EP + dvp_EP);
B_EP = ((0.5)*dvp_EP) - (2*((1./vpvs_EP + 1./vpvs_ob)./2).^2).*(dd_EP + 2.*dvs_EP);

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## plot figure

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figure(1)
h = plot(anginc,Rpp2,'r','linewidth',3);
hold on
h = plot(anginc,Rpp3,'b','linewidth',3);
axis([0 45 -0.05 0.15]);
set(gca,'fontweight','bold','fontsize',10)
xlabel('Incident angle (Degrees)','fontsize',14);
ylabel('P-wave Reflection Coefficient','fontsize',14);
grid;
pos = 4;
h = legend('Lyr-Spekke-Melke-on-Garn-6506/12-1','Lyr-Garn-6506/12-1',pos);
set(h,'fontsize',14);
set(h,'fontweight','bold');
h = title('Interface reflection between Lyr-Spekke-Melke Ontop Garn Fms and Lyr Ontop Ga
rn Fms. at 50MPa','fontsize',14);
%
% Save a tiff picture
%
print -dtiff fig1.tif
%
figure(2);
h = plot(A_2_5,B_2_5,'marker','o','markeredgecolor','k','markerfacecolor','r','LineStyle'
,'none');
set(h,'markersize',8);
set(gca,'fontweight','bold','fontsize',10);
axis([-0.5 0.5 -0.5 0.5]);
xlabel('Intercept (A)','fontsize',14);
ylabel('Gradient (B)','fontsize',14);
grid
hold on
h = plot(A_12_1,B_12_1,'marker','o','markeredgecolor','k','markerfacecolor','b','LineStyl
e','none');
set(h,'markersize',8);
% h = plot(A_EP,B_EP,'marker','d','markeredgecolor','k','markerfacecolor','k','LineStyle'

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,'none');
% set(h,'markersize',8);
% ca = [P_diff(1) P_diff(end)]/1e6;
% h = scatter(A_EP,B_EP,80,(P_diff/1e6),'fill','d');
% caxis(ca);
% colorbar;
h = plot(A_12_1,B_12_1,'marker','o','markeredgecolor','k','markerfacecolor','b','LineStyle','none');
set(h,'markersize',8);
h = plot([-0.5,0.5],[0.5,-0.5],'--k','linewidth',3);
h = plot([-0.5,0.5],[0,0],'--k','linewidth',2);
h = plot([0,0],[-0.5,0.5],'--k','linewidth',2);
% h = legend('6406/2-5','6506/12-1','Eberhart-Phillips',1);
h = legend('Lyr-Spekke-Melke-on-Garn-6506/12-1','Lyr-Garn-6506/12-1',1);
set(h,'fontsize',14);
set(h,'fontweight','bold');
h = title('Intercept vs. Gradient - Lyr-Spekke-Melke Ontop Garn Fms and Lyr Ontop Garn Fms.at 50MPa','fontsize',14);
%
% Save a tiff picture
%
print -dtiff fig2.tif
%
figure(3);
h = plot(P_diff/1e6,vp_EP,'k','linewidth',3);
set(gca,'fontweight','bold','fontsize',10);
axis([0 40 1 5]);
xlabel('Differential stress (MPa)','fontsize',14);
ylabel('Velocity (km/s)','fontsize',14);
grid
hold on
h = plot(P_diff/1e6,vs_EP,'--k','linewidth',3);
h = plot([16],[vp2/1e3],'marker','o','markeredgecolor','k','markerfacecolor','r','LineStyle','none');
set(h,'markersize',8);
h = plot([16],[vs2/1e3],'marker','s','markeredgecolor','k','markerfacecolor','r','LineStyle','none');
set(h,'markersize',8);
h = plot([16],[2642.1/1e3],'marker','d','markeredgecolor','k','markerfacecolor','r','LineStyle','none');
set(h,'markersize',8);
h = plot([36],[vp4/1e3],'marker','o','markeredgecolor','k','markerfacecolor','b','LineStyle','none');
set(h,'markersize',8);
h = plot([36],[vs4/1e3],'marker','s','markeredgecolor','k','markerfacecolor','b','LineStyle','none');
set(h,'markersize',8);
h = plot([23],[4330/1e3],'marker','o','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
set(h,'markersize',8);
h = plot([23],[2804/1e3],'marker','s','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
set(h,'markersize',8);
h = legend('Vp - E-P-model (1989)','Vs - E-P-model (1989)','Median Vp - 6406/2-5','Median Vs - 6406/2-5',...
'Median Vs-GC - 6406/2-5','Median Vp - 6506/12-1','Median Vs - 6506/12-1','Mean Vp - 6406/6-1','Mean Vs-GC - 6406/6-1');
set(h,'fontsize',10);
set(h,'fontweight','bold');
set(h,'Location','southeast');
h = title('Velocity vs. differential stress - Garn Fm','fontsize',14);

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%
% Save a tiff picture
%
print -dtiff fig3.tif
%
figure(4);
h = plot(P_diff/1e6, vp_EP./vs_EP, 'k', 'linewidth', 3);
% h = plot(P_diff/1e6, vp_EP./vs_EP, 'marker', 'o', 'markeredgecolor', 'k', 'markerfacecolor', 'y', 'LineStyle', 'none');
% set(h, 'markersize', 8);
set(gca, 'fontweight', 'bold', 'fontsize', 10);
axis([0 40 1.4 1.8]);
xlabel('Differential stress (MPa)', 'fontsize', 14);
ylabel('Vp/Vs', 'fontsize', 14);
grid
hold on
h = plot([16], [vp2/vs2], 'marker', 'o', 'markeredgecolor', 'k', 'markerfacecolor', 'r', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = plot([16], [vp2/2642.1], 'marker', 'd', 'markeredgecolor', 'k', 'markerfacecolor', 'r', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = plot([36], [vp4/vs4], 'marker', 'o', 'markeredgecolor', 'k', 'markerfacecolor', 'b', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = legend('Vp/Vs - E-P-model (1989)', 'Median Vp/Vs - 6406/2-5', 'Median Vp/Vs-GC - 6406/2-5', 'Median Vp/Vs - 6506/12-1', pos);
set(h, 'fontsize', 10);
set(h, 'fontweight', 'bold');

h = title('Velocity ratio vs. differential stress - Garn Fm', 'fontsize', 14);
%
% Save a tiff picture
%
print -dtiff fig4.tif
%
vp_EP = 5.77 - 6.94*(0.15) - 1.73*(sqrt(0.05)) + 0.446*(P_diff/1e8 - 1.0*exp(-16.7*P_diff/1e8));
vs_EP = 3.70 - 4.94*(0.15) - 1.57*(sqrt(0.05)) + 0.361*(P_diff/1e8 - 1.0*exp(-16.7*P_diff/1e8));
%
figure(5);
h = plot(P_diff/1e6, vp_EP, 'k', 'linewidth', 3);
set(gca, 'fontweight', 'bold', 'fontsize', 10);
axis([10 60 0 5]);
xlabel('Differential stress (MPa)', 'fontsize', 14);
ylabel('Velocity (km/s)', 'fontsize', 14);
grid
hold on
h = plot(P_diff/1e6, vs_EP, '--k', 'linewidth', 3);
h = plot([20], [4415/1e3], 'marker', 'o', 'markeredgecolor', 'k', 'markerfacecolor', 'r', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = plot([20], [2667/1e3], 'marker', 's', 'markeredgecolor', 'k', 'markerfacecolor', 'r', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = plot([36], [4501/1e3], 'marker', 'o', 'markeredgecolor', 'k', 'markerfacecolor', 'm', 'LineStyle', 'none');
set(h, 'markersize', 8);
h = plot([36], [2737/1e3], 'marker', 's', 'markeredgecolor', 'k', 'markerfacecolor', 'm', 'LineStyle', 'none');

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set(h,'markersize',8);
h = plot([50],[4565/1e3],'marker','o','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
set(h,'markersize',8);
h = plot([50],[2788/1e3],'marker','s','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
set(h,'markersize',8);
% h = plot([23],[2804/1e3],'marker','s','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
h = legend('Vp - E-P-model (1989)','Vs - E-P-model (1989)',' Vp Well at 20MPa (Injection)',
' Vs Well at 20MPa (Injection)',...
' Vp Well at Insitu 36MPa',' Vs Well at Insitu 36MPa ','Vp Well at 50MPa (Depl
etion)',' Vs Well at 50MPa (Depletion)');
% h = legend('Vp - E-P-model (1989)','Vs - E-P-model (1989)',pos);
set(h,'fontsize',10);
set(h,'fontweight','bold');
h = title('Velocity vs. differntial stress','fontsize',14);
%
% Save a tiff picture
%
print -dtiff fig5.tif
%
figure(6);
h = plot(P_diff/1e6,vp_EP./vs_EP,'k','linewidth',3);
% h = plot(P_diff/1e6,vp_EP./vs_EP,'marker','o','markeredgecolor','k','markerfacecolor','y','LineStyle','none');
% set(h,'markersize',8);
set(gca,'fontweight','bold','fontsize',10);
axis([0 40 1.4 2.8]);
xlabel('Differential stress (MPa)','fontsize',14);
ylabel('Vp/Vs','fontsize',14);
grid
h = legend('Vp/Vs - E-P-model (1989)',pos);
set(h,'fontsize',10);
set(h,'fontweight','bold');
h = title('Velocity ratio vs. differntial stress','fontsize',14);
%
% Save a tiff picture
%
print -dtiff fig7.tif
%
figure(8);
h = plot(P_diff/1e6,dVp_dPe,'k','linewidth',3);
set(gca,'fontweight','bold','fontsize',10);
axis([0 40 0 8]);
xlabel('Differential stress (MPa)','fontsize',14);
ylabel('dV/dP_{diff} (km/s/MPa)','fontsize',14);
grid
hold on
h = plot(P_diff/1e6,dVs_dPe,'r','linewidth',3);
h = plot(P_diff/1e6,dVp_dPe./dVs_dPe,'g','linewidth',3);
h = legend('dVp/dP_{diff} - E-P-model (1989)','dVs/dP_{diff} - E-P-model (1989)','dVp/dVs
- E-P-model (1989)',1);
set(h,'fontsize',10);
set(h,'fontweight','bold');
h = title('Velocity vs. differntial stress','fontsize',14);
%
% Save a tiff picture
%
print -dtiff fig8.tif

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