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Strong texture inheritance between perovskite and post-perovskite in the D'' layer.

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The main mineral in the lower mantle, magnesium-silicate perovskite, transforms into a high-pressure, post-perovskite, phase at pressures and temperatures corresponding to the D'' seismic discontinuity approximately 200 km above the core-mantle boundary[1,2]. The strong elastic anisotropy of post-perovskite has been invoked to explain the observed seismic anisotropy and to infer flow in the D'' region, based on models of textured post-perovskite[3-5]. Such inferences rely on a knowledge of the mechanisms by which the post-perovskite can obtain texture. It is generally thought that seismic anisotropy in D'' is produced from lattice-preferred orientation generated during plastic deformation[6-10]; however, it is difficult to explain all of the observed seismic anisotropy in D'' using a single deformation mechanism in post-perovskite. Here we show that strong texture inheritance is possible during

The present interpretation reconciles the regional and global seismic studies whilst also being consistent with the positive Clapeyron slope of the transition between perovskite and post perovskite. It also raises the interesting possibility that studies which compare the shear-wave velocity with shear-wave anisotropy might be able to map out the extent of post-perovskite stability in D''. In addition, the generation of texture in post-perovskite has been invoked as a means to produce a D'' reflector even with gradual transformation from perovskite to post-perovskite[24]. In a similar manner, perovskite which formed by transformation of post-perovskite will have a texture which varies strongly from that of perovskite in the overlying mantle which never entered the post-perovskite stability field. The resultant change in seismic anisotropy between these two regions of perovskite might explain the persistence of a D'' reflector in the large, low-shear velocity provinces where post-perovskite is thought not to be stable.

Further work is required to confirm that the transformation mechanism observed here operates in the Earth. Martensitic transformation is enhanced compared to reconstructive transformation mechanisms by metastable overstep, which was large in the experiments and is likely to be small at the temperatures of D'', and by shear deformation, which was zero in the experiments but certainly occurs in D''. In addition, martensitic transformation under conditions of shear deformation is likely to have a further selectivity in the orientation of the daughter phase (ie both of the twin domains in the post-perovskite will not be equally developed), slightly modifying the textures which we predict here. This will not, however, significantly alter the conclusions since the difference in orientation between the two twin domains is small. Experiments are currently being performed to determine the strength of the selectivity during transformation in non-hydrostatic stress fields.

We have chosen to concentrate in this paper on the effect of topotaxy during the 'retrograde' transformation from post-perovskite to perovskite; however, similar effects will obtain during the 'prograde' reaction to post-perovskite. Since (010) planes are thought to be the weakest glide planes in perovskite[14,15], subducting slab material will generate a texture on entering D'' with {110} post-perovskite planes parallel to the shear direction. Any transformation texture produced in this way should

Jw6r/scev srlf2lv2fet-hd6r

&oSheuD phatPepUoat og leotPoUonh,uoa tyDmtmpulnPDlompart 6otDapneh,pftUpmfJmDm pftmJfhSmpm oa t

HV1CZt uhPont HQhnpaDept o t Dndt zZt Dmt pu,nouoa oPt 0Et bo0oamh6at DaPt ThuHtzBpmt D,,ehDf6t pmt

PompraoPt htfD, leot 6otpa oeDf phamt0o yooatfeEm Dnmtpat0fEmDnnpaotmhnpPtlaPoerhpartuDfehnhfh,pf

m eDpaty6oat 6otpaPpUpPlDntfeEm Dnmt PoSheut0Et PpmnhfD phatfeoo,t DaPtpa oeDf typ 6tDPDfoa tfeEm Dnm

Po DpnmthSt 6otD,,ehDfDaPtoh,6EmpfDnnEteonoUDa togDu,nomtfDat0otShlaPtpatHfvmto tDndtDKtaBpf

o tDndBKtLVtThuuDmpto tDndtzKt5LLLMtR Dnvoeto tD5ldtzKtRoavto tDndt5LLVKt5LzzZdt.oeotyothanEtah ot 6D t

6ot voEt Dmmlu, phamt Deot 6D t oDf6t feEm Dnt PoSheumt hanEt 0Et m eDpat hat Dt mo t hSt m,ofpSpoPt mnp,t m

og6p0p part Dt Upmfm pft e6ohnhrpfDnt nDyKt DaPt 6D t m eommt oNlpnp0eplut DaPt m eDpmfEtufDaPp phamt

pu,npoPt 0Et 6ot pa oeDf phamt Deot pafhe,heD oPt pat Dat DUoeDrot yDEt lnmpr tDt

6huhroapmD phatD,,ehgpuD phadt1parnotfeEm Dntmnp,tmEm out,DeDuo oemtlmoPt htmpulnD otQr1p9st,oehUmv

DaPt,hmü,oehUmvp otDeotnpm oPtpatTDzdtRotah ot 6D t 6oeotpmtfhampPoeD0notfha ehUoemEtDmt ht 6otuhm t

Df pUotmnp,tmEm oumtpatPoSheupa,rtehmUmvp otDaPtyot 6oeoSheotDPh, t 6eootuhPonmtpa oaPoPt htm,Dat

6oteDarothStfleeoa tlafoe Dpa Edt tRotuDvotlmothSt 6otTDaroa thPontbo0oamh6atDaPthTKtzBZt ht

,DeDuo oepmot 6otpa oeDf phamt0o yooatfeEmrDnmd

t

/fg2srJ3x*t1np,tmEm outfep pfDnteomhnUoPtm eommomtlmoPtShetV1CtfDnflnD phamdtBDf6thSt 6otmtmnp,tmE*

Shnnhypat 6otUpmfJmDm pft nDty $\dot{\gamma}_0^s = \dot{\gamma}_0 \left(\frac{\tau_r^s}{\tau_0^s}\right)^{n^s}$ *t y6oeotLtpmt Dt eoSoeoafot m eDpatD pKt Dt eoSoeoafot m6oDet*

m eommtkpmt 6otm eoeomhnUoPthat 6otmnp,tmEm outDaPtDtm eommtog,haoa tHDnyDEmt DvoatDmtstpat 6om

fDnflnD phamZdt cht imp,m out 6DePoapart nDyt pmt pu,hmoPdt T6ujt,ehmUmvp ot uhPonmt Deot 6hmot lmoPt 0Et

RDnvoeto tDndtH5LzzZtyp 6tWWUtWzLLtlmpart 6ot,DeDuo oemthStQoevonto tDndtH5LLäZtSDUhlepartmnp,that 6ot

DaPtHzLLZt,Daomd WWUtWLzLtpmt DvoatSehut 6otWzDDeemtuhPonnparthStCDeeoto tDndtH5LLäDKt5LLä0ZtDaPt

Qo mloto tDndtH5LLZtDaPtyp 6tmnp,that 6otHLzLZtaDupart0l typ 6tDteD 6oetpmh eh,pftEponPSDfdeWWUt

WLLztpmtpa oaPoPt htrpUotmnp,that 6otHLLzZt,nDaotDmth0moeUoPt0EtQpEDrpto tDndtH5LzLZdtihet,oehUmvp ot

lmot,DeDuo oemt Sehut 6ot zLLt wWDt fDnflnD pha

mEmu tfDaah t0otDf pUD oPtShet 6ot,De pflnDet,DeDuo oetmo d

t

1np,t1											

t

t

Rot DPh, t Dt mpu,not D,,ehDf6t ht mpulnD ot PoSheuD phat pat 6ot nhyoeuhm t uDa not D0hUot 6ot fheotnuDa

0hlaPDeEt DaPt fhampPoet uDa not PoSheuD phat ht0ot PhupaD oPt 0Et 6hepha Dnt mpu,not m6oDedt Jmpart 6ot

uhPont yot roaoeD oPt Dt Pomfep, phat hSt nD pfot ,eoSoeeoPt hepoa D phat HbW9Zt Shet 6pmt PoSheuD phat m Enodu

PpSSpfln Et yp 6t 6pmt D,,ehDf6t pmt 6hyt 6ot m e

uh phatpmtlanpvonEt ht0ot 6othanEtuof6Dapmut,oeup partPoSheuD phatDaPt 6otDuhla thStPpmnhfD phatuh p

pmmonStnpup partDmtPpmnhfD phatuln p,npfD phatDaPtpa oeDf phamt0o yooatPpmnhfDtphtmoDPtnhtmoaP,

mEm out6DePoapartyp 6tpafeoDmpartm eDpadtT6pmKtpat leaKtpa ehPlfpartmhuotDe0p eDeEt6DePoapartnDytyotDffo, t 6D tbW9typnnt

6ot uh phat hSt ,hpa t PoSof mdt T6oeot pmt aht og,oepuoa Dnt PD Dt hat 6hyt NlpfvnEt 6pmt ,ehfommt h,oeD omt p

nhyoeuhm tuDa not,6DmomtmhKtpDmhStpa ehPlfpartmhuotDe0p eDeEt6DePoapartnDytyotDffo, t 6D tbW9typnnt

0ot roaoeD oPt laeoDnpm pfDnnEt NlpfvnEt Dmt uD oepDnt pmt m eDpaoPdt It mofhaPt fha ehnt hat 6ot m,ooPt hSt

PoUonh,uoa tpmt 6otUDepD phatpmt6DePaommthStPpSSoeoa tmnp,tmEm oumtfDatDffo, tm eDpatyp 6taoDetoNlDntUDnlomthSt 6opetfep pfDnteomhnUoPtm6

mleSDfoZdt tuDaEtmnp,tmEm oumtfDatDffo, tm eDpatyp 6taoDetoNlDntUDnlomthSt 6opetfep pfDnteomhnUoPtm6

feEm Dnmtyp 6tPpSSoeoa thepoa D phamtypnnt oaPt htmnp,thatPpSSoeoa tmnp,tmEm outDaPt 6lmtah teh D otpat

Ppeof phadt9at 6oth 6oet6DaPKtpSthaot,De pflnDetmnp,tmEm outpmtulf6tyoDvoet 6Dat 6oth 6oemtuDaEthSt 6

feEm Dnmtypnnt oaPt hteh D ot htDnprat 6pmtmEm out ht0om tDffhuuhPD ot 6otuDfehmfh,pftm eDpaKtNlpfvnEtrp

Dtm ehart og leodtT6otDapmh eh,EthSt 6otmpeEmoDntEponPtmleSDfotpmtDnmhtah tvahyatShetnhyoeuhm tuDa no

,6DmomdtT6otao toSSof thSt 6omotlafoe Dpa pomtpmt 6D t 6otm eoar 6thSt 6ot og leotPoUonh,oPtSehut 6ot1C

mpulnD phamtypnntah t0otfhu,DeD0not ht 6otm eoar 6thSt 6ot elot og leotpat 6otBDe6dtDJ,ehDf6omt

6DUot0ooat Dvoatpat,eoUphlmtyhevt ht6DaPnot 6pmtPpSSpfln EtpafnlPpartDPPpartDtnDerotpmh eh,pftfhu,haoa t

6otfDnflnD oPt ogleotHRoavto tDnKt5LzzZKtmfDnpartuDrap lPothSt 6otD,,npoPtm eDpatHQoevonto tDndKt5LLäZth

hanEtfhampPoepart 6otheDpathSt 6oteomln partonDm pftDapmh eh,EtDaPtah tp mPotDhpDfvpto tDndKtpat

eoUpoyZdt.oeoKtyoteoPlfot 6otuDrap lPothSt 6otD,,npoPtm eDpat htnoUont 6D t,ehPlfomt og leotDaPtmopmupft

Dapmh eh,Et hSt Dt eoDmhaD0not m eoar 6t DaPt D,,nEt Dt h Dnt m6oDetmEDpat ht GLLt ,hm ü,oehUmvp ot

feEm Dnmtyp 6tDatpap pDnnEteDaPhutPpm ep0l phathSthepoa D phamtpat 6pe EtSpUotm o,md

t

9afot 6ot ,hm ü,oehUmvp ot PoSheuD phat og leot 6Dmt 0ooat roaoeD oPt yot fDnflnD ot 6ot onDm pft DaPt mopmupf

Dapmh eh,Et 0Et Sheupart 6thpr ü olmnüpnnt DUoeDrot hSt 6ot GLLt eh D oPt onDm pft m pSSaommt oamhemdt T

DrreorD otonDm pfp Etpmt lmoPt htfDnflnD ot 6otUonhfp pomthSt 6otDaPt1ü,pftUmtDaPt 6lmt 6otmopmupft

Dapmh eh,Edt T6omotfDnflnD phamt Deot ,oeSheuoPt lmpart 6ot Q1ITt mhS yDeot HRDPtVhetDoEKt 5Lz5Zdt t

hePoet ht fhu,Deot yp 6t uhPonmt hSt rnh0Dnt mopmupft Dapmh eh,Et y6pf6t pu,hmot Uoe pfDnnEt eDamUoemot pml

H t hat 6ot PD Dt yot fDnflnD ot 6ot Uonhfp Et hSt Uoe pfD nEt lDaPt 6hepa DnnEt ,hnDepmoRyD Uomt

,eh,DrD part,DeDnnont ht 6ot otuDa not0hlaPDeEtHCQtDaPt 6otUonhfp EthStDUomt,eh,DrD partaheuDnt ht

H ZtDaPt,DeDnnont ht 6otCQpatDtuoPpluthaty6pf6t 6Dmt0ooatpu,hmoPdtRotpu,hmot 6pmtmEuuo eEt

0EtSheupart 6ot hpr ülmmüpnntDUoeDrotonDm pfp EthStuDaEteo,npfDmthSthDetpD oamheteh D oPtDehlaPt

6otUoe pfDntDgpmdtRot 6oatog eDf t 5 8 5 tt DaPt 5 8 5 t,DeDuo oemtlmlDnnEteo,he oPtpatm lPpomt

hStrnh0Dntmopmupft Dapmh eh,EdtT6omotDeoteo,he oPtpat TD0not15dt

t

/fg2sr JA x t WDeDuo oemt Pomfep0part 6ot Dapmh eh,Et hSt g leomt m6hyat pat iprleot 5t hSt 6ot uDpat t S oet

pu,hmpart hat 6otroaoeDnnEtDapmh eh,pfteomln mdt2oehtpmtp mh eh,pfd

t

1 DrothStmpulnp ha	t	t	na Z t	t	t	na Z t	
Hmootiprleot5Z	t	t	t				
HD Z	t	t	t	ä d-G t	t	t	zdLz t
H0 Z	t	t	t	ü d5- t	t	t	zd-5 t
Hf Z	t	t	t	ü Ldz V t	t	t	ü dV t

t

t

Tht oUDnlD o 6ot Dapmh eh,Et DS oet 6ot , ü ehUmvp ot ht ,oehUmvp ot ,6Dmot eDamp phat H0t pat TD0not 15ZKt Da

mpulnD ot 6otoSSof thSt6oD part 6otuDa notDmtp tuhUomtDfehmmt 6otfheotuDa not0hlaPDeEKtyot hhvt 6ot og leot

hSt 6otm eDpat, ü ehUmvp oKteh D oPtoDf6tfeEm D t Dfpart ht 6otog,oepuoa DnnEtPo oeupaoPthepoa D phat

eonD pham6p,t 0o yooat 6ot yht ,6Dmomt DaPt 6oat oUDnlD oPt 6ot mopmupft Dapmh eh,Et Dmmlupart zLL

fhaUoemD phatSehut,hüoehUmvp ot ht,oehUmvp odt thePoet htPht 6pmtyotSpem tSheuoPtlap tUof hemtDnhart 6o

,epafp,Dnt Dgomt hSt 6ot ,hüoehUmvp ot feEm DnKt DaPt pat 6ot Ppeof phamt og,of oPt Shet 6ot ,oehUmvp ot feEm L

HeDaPhunEtDaPtlapSheunEtf6hhmpart0o yooatfDmomtyt ,UtLU,UtDaPtLU,Ut ü L,Ut ht

Dffhla t Shet 6ot ,hm ü,oehUmvp ot ypaaparZdt T6omot U hDeot 6oat lmoPt ht 0lpnPt Dt eh D phat uD epgt ht

Pomfep0ot 6ot oSSof t hSt 6ot,6Dmot eDamp phat hat oDf6t feEm Dndt T6ot fhPot lmoPt Shet 6pmt,ehfommt Sheumt L

lmDrot ogDu,not Shet 6ot Q1ITt hhnvp t DaPt ypnnt0ot DUDpnD0not Shet PhyanhDPt Dmt,De t hSt 6ot aog t upahet eoUp

HUoemphatzdt t ,8 8yyyzdrnEd0epmdDfdlv8Q1IT8Zdt

t

thePoet htSle 6oetPo oeupaot6hytnhart 6ot eDamSheuoPt og leotfDat,oempm tpat 6otnhyoetuDa notlaPoerhpart

Sle 6oetPoSheuD phatyot,oeSheuoPtDPPp phaDnt V1CtfDnflnD phamthat,oehUmvp otDrreorD omtm De partSehut 6o

fDnflnD oPt eDamSheuoPt og leotHft pat TD0n Zdt 6pnot 6ot og leot DaPt mopmupft Dapmh eh,Et Phomtf6Darot 6pmt

f6Darot pmt ah t Dmt,ehShlaPt Dmt 6ot PpSSoeoafot 0o yooat,oehUmvp ot DaPt,oehUmvp ot DaPt uDpa Dpamt 6ot

mDuot0DmpftmpraD leothStSDm tUoe pfDnnEt,hnDepmoPtm6oDetyDUomtDaPtmnhyt6hepmo6DDetyDUomtDepmoPt

tt

t

CDeeoKtWdKt&dtioeeKtDaPtWdtChePpoetH5LLäDZKt,npfD phamtShet,nDm pftSnhytpat 6otPoo,tuDa notSehutuhPo

PpmnhfD phamtpatQ,1up9aoeDnmKtcD leoKt--VK tV Kt Php LdzLs8aD leoL GG8d t

CDeeoKt WdKt &dt ioeeKt DaPt Wdt ChePpoet H5VLüp0ZKtDDeeht uhPont Shet PpmnhfD phamt pat ,Q,1up9ü

,oehUmvp ot fDnflnD oPt D t z5Lt wWDt Sehut Spem t ,epafp,W6pnhmdt QDrdKt KtssS5-5Kt

Php LdzLL8z-äV-sLäLz5V -d t

bo0oamh6aKt t IdKt DaPt Cdt cdt ThuHZZKt It monSfhampm oa t Dapmh eh,pft D,,ehDf6t Shet 6pulnD phat hSt

,nDm pftPoSheuD phatDaPt og leotPoUonh,adthSt,hnEfeEm Dnmt ,,npfD phat ht efhaplutDnnhEfnDKt

Qo DnndtQD okt HZKt5Vz5V5-KtPhp LdzLzV8L6V üzGzHsZZzsL ü t

QDpa,epfoto tDndtH5ZKtBW1bt5äzsüG--d t

QoevonKt 1dKt Idt tQfcDuDeDKt hKt 1dt 1,opDnoKt bdt QpEpKt QoarKt Tdt 1dt &lSSEKt DaPt RoavtH5LLäZKt

&oSheuD phat hSt HQrKioZ1µ9,hmü,oehUmvp ot DaPt "& Dapmh eh,EKt 1fpoafoKt szVKt zSt5Kt

Php LdzzV8mfpoafodzzLVL t

Qo mloKt IdKt Wdt CDeeoKt &dt QDpa,epfoKt DaPt Wdt ChePpoet H5LLZKt Ponnpart hSt PpmnhfD phamt DaPt

PoSheuD phatuof6DapmumtpatCDeDaPtQrwo9st,hmü,oehUmvp ontChu,Depmhatyp 6tQr1p9t,hmü

,oehUmvp oKtW6EmdtBDe 6tWnDao dt oedKtzKtVLpLdzLzV8o,pd5LLL - dLLst

QpEDrpKtdtRdDap ,DaEDf6DehoaKtWdtDoef6aKtdtQdtbooKtDaPtdtRoavtH5LzLZKt1np,tmEm oumtpatQs1p9

,hmü,oehUmvp oDpu,npfD phamtSh'tDapmh eh,EKt 1fpoafoKts5KtzVSWsD QhnpaDepKt IdKtwdtCDahUDt

DaPt1dt6DttIfeotQo DnndKtsGtHzDZt5d t

chyDfvpKt IdKt Idt Qdt RDnvoeKt dt RhhvoEKt DaPtQdt DaPD nnt Hpat eoUpoyZt 1l0up oPt ht woh,6EmpfDnt DleaDnt

D oeaD phaDnt

DfvmKt Jdt idKt Cdt cdt ThuKt DaPt üdt Roav t t HzDt Tog leot DaPt Iapmh eh,Edt WeoSoeeoPt 9epoa D phamt pat

WhnEfeEm DnmtDaPtT6opetBSSof thatQD oepDnmtKtCDaeapmtJapUdtWeommKtPDaKt dtdt

ThuuDmpKtIdKtIdtdtTpvhSSKtDaPtIdtDlf6otHzDKtJ,,oetuDa not of hapfmt6eoo üPpuoamphaDntPoSheuD phaKt

hnpUpaotfeEm DnnhreD,6pftSD0epfmtDaPtmopmupft,eh,oe pomKtBDe 6tWnDao dt5ZKtbäzKtVEz

Php LdzLzV81LLz5 üzEtLLL-V üzdt

ThuuDmpKtIdKtdtQDpa,epfoKtwdtCDahUDKtDaPtdtC6Dm ontH5LLLZKtpmfh,nüpmpfmmonStDaPtoNlpnp0eüplu

0DmoPtuhPonparthSthnpUpaotnD pfot,eoSoeeoaPDhepamtD,npfD phamtShet 6otl,,oetuDa notmopmupft

Dapmh eh,EKtwoh,6EmdtmdKtzLGKtäüdt

RDnvoeKt Idt QdDaPt dt RhhvoEt H5Lz5Zt Q1ITt üt It aoyt hhnvp t Shet 6ot DaDnEmpmt hStfoDaPtmopmupft

Dapmh eh,EChu,l oemtDaPtwohmfpoafomKt-Kt,dü dtPhpLdzLzV8fDrohd5Lz5dLGdLstz

RDnvoeKt Idt QdKt Idt Qdt ihe oKt Rhh Idt hyDfvpt DaPt Qdt PDnnt H5LzzZt Dm pft Dap hSt &'t

,eoP pf oPt Sehut rnh0Dnt uhPonmt hSt uDa not Snhy wohf6oupm eEKt wohf6 ohmEm oumKt z5Kt De dahdt

LLLVdtPhp LdzL5 5LzzwCLLsäs5 t

RoavKt .d Kt 1dt 1,o Dno Kt Idt Qt QfcDuDeDKt DaPt Bdt Qt wDeaoeht H5LLVZKt QhPonpart nhyoet uDa not Dapmh eh,E

PoUonh,uoa tpat Dml0Plf partmnD0KtBDe 6tWn Dfpdo dKt5-GKtsL sz-d t

RoavKt .d Kt 1dt Ch DDeKt Cdt cdt Thu Kt Idt QfcDuDeDKt DaPt Qt uDahypf H5LzzZKt &oSheuD phat pat 6ot

nhyoeuhm t uDa no iehut,hnEfeEm Dnt,nDm pfp Et ht mopmupft Dapmh eh,EKt BDe 6t WnDao dt 1fpdt bo dKt

ss -GKtPhp LdzLzV8 o,mnd5LzzdLsdL5 d

t