

IASPEI STANDARD SEISMIC PHASE LIST (DRAFT)

At its meeting in Hanoi, August 23, 2001 the IASPEI Commission on Seismological Observation and Interpretation decided to set up a Working Group on Standard Seismic Phase List. The final product of the WG is supposed to be recommended by the IASPEI for use in data exchange between seismic observatories, local, regional, and international data centres. The members of the WG are (in alphabetical order): R.Adams, P.Bormann, R.Engdahl, J.Havskov, B.Kennett, J.Schweitzer, and D.Storchak (Chairman).

CRUSTAL PHASES

- Pg** At short distances, either an upgoing P wave from a source in the upper crust or a P wave bottoming in the upper crust. At larger distances also arrivals caused by multiple P-wave reverberations inside the whole crust with a group velocity around 5.8 km/s.
- P*** (alt: Pb) Either an upgoing P wave from a source in the lower crust or a P wave bottoming in the lower crust below the Conrad discontinuity (Conrad)
- Pn** An upgoing P wave from a source between the Mohorovicic discontinuity (Moho) and the base of the asthenosphere or any P wave bottoming in the upper mantle not deeper than the base of the asthenosphere
- PnPn** Pn free surface reflection
- PgPg** Pg free surface reflection
- PmP** P reflection from the outer side of the Moho
- PmPN** PmP multiple free surface reflection; N is a positive integer.
For example, PmP2 is PmPPmP
- PmS** P to S reflection from the outer side of the Moho

Sg At short distances, either an upgoing S wave from a source in the upper crust or an S wave bottoming in the upper crust. At larger distances also arrivals caused by superposition of multiple S-wave reverberations and SV to P and/or P to SV conversions inside the whole crust. The maximum energy of this wave travels with a group velocity around 3.5 km/s and is called Lg.

S* (alt: Sb) Either upgoing S wave from a source in the lower crust or an S wave bottoming in the lower crust below the Conrad

Sn An upgoing S wave from a source between the Moho and the base of the asthenosphere or any S wave bottoming in the upper mantle not deeper than in the asthenosphere

SnSn Sn free surface reflection

SgSg Sg free surface reflection

SmS S reflection from the outer side of the Moho

SmSN SmS multiple free surface reflection; N is a positive integer.

For example, SmS₂ is SmSSmS

SmP S to P reflection from the outer side of the Moho

Lg See Sg

Rg Short period crustal Rayleigh wave

MANTLE PHASES

P A longitudinal wave, bottoming below the asthenosphere; also an upgoing longitudinal wave from a source below the asthenosphere

PP Free surface reflection of P wave leaving a source downwards

PS P, leaving a source downwards, reflected as an S at the free surface

PPP analogous to PP

- PPS** PP to S converted reflection at the free surface; travel time matches that of PSP
- PSS** PS reflected at the free surface
- PcP** P reflection from the core-mantle boundary (CMB)
- PcS** P to S converted reflection from the CMB
- PcPN** PcP multiple free surface reflection; N is a positive integer.
For example PcP2 is PcPPcP
- Pz+P** P reflection from outer side of a discontinuity at depth z; z may be a positive numerical value in km. For example P660+P is a P reflection from the top of the 660 km discontinuity.
- Pz-P** P reflection from inner side of discontinuity at depth z. For example, P660-P is a P reflection from below the 660 km discontinuity, which means it is precursory to PP.
- Pz+S** P to S converted reflection from outer side of discontinuity at depth z
- Pz-S** P to S converted reflection from inner side of discontinuity at depth z
- PScS** P (leaving a source downwards) to ScS reflection at the free surface
- Pdif** (old: Pdiff) P diffracted along the CMB in the mantle
 - S** A shear wave, bottoming below the asthenosphere; also an upgoing shear wave from a source below the asthenosphere
 - SS** Free surface reflection of an S wave leaving a source downwards
 - SP** S, leaving source downwards, reflected as P at the free surface
 - SSS** analogous to SS
 - SSP** SS to P converted reflection at the free surface; travel time matches that of SPS
 - SPP** SP reflected at the free surface

- ScS** S reflection from the CMB
- ScP** S to P converted reflection from the CMB
- ScSN** ScS multiple free surface reflection; N is a positive integer.
For example ScS2 is ScSScS
- Sz+S** S reflection from outer side of a discontinuity at depth z; z may be a positive numerical value in km. For example S660+S is an S reflection from the top of the 660 km discontinuity.
- Sz-S** S reflection from inner side of discontinuity at depth z. For example, S660-S is an S reflection from below the 660 km discontinuity, which means it is precursory to SS.
- Sz+P** S to P converted reflection from outer side of discontinuity at depth z
- Sz-P** S to P converted reflection from inner side of discontinuity at depth z
- ScSP** ScS to P reflection at the free surface
- Sdif** (old: Sdiff) S diffracted along the CMB in the mantle

CORE PHASES

- PKP** (alt: P') unspecified P wave bottoming in the core
- PKPab** (old: PKP2) P wave bottoming in the upper outer core; ab indicates the retrograde branch of the PKP caustic
- PKPbc** (old: PKP1) P wave bottoming in the lower outer core; bc indicates the prograde branch of the PKP caustic
- PKPdf** (alt: PKIKP) P wave bottoming in the inner core
- PKPpre** (old: PKhKP) a precursor to PKPdf due to scattering near or at the CMB
- PKPdif** P wave diffracted at the inner core boundary (ICB) in the outer core
- PKS** Unspecified P wave bottoming in the core and converting to S at the CMB
- PKSab** PKS bottoming in the upper outer core

- PKSbc** PKS bottoming in the lower outer core
- PKSdf** PKS bottoming in the inner core
- P'P'** (alt: PKPPKP) Free surface reflection of PKP
- P'N** (alt: PKPN) PKP reflected at the free surface N-1 times; N is a positive integer. For example P'3 is P'P'P'
- P'z-P'** PKP reflected from inner side of a discontinuity at depth z outside the core, which means it is precursory to P'P'; z may be a positive numerical value in km
- P'S'** (alt: PKPSKS) PKP to SKS converted reflection at the free surface; other examples are P'PKS, P'SKP
- PS'** (alt: PSKS) P (leaving a source downwards) to SKS reflection at the free surface
- PKKP** Unspecified P wave reflected once from the inner side of the CMB
- PKKPab** PKKP bottoming in the upper outer core
- PKKPbc** PKKP bottoming in the lower outer core
- PKKPdf** PKKP bottoming in the inner core
- PNKP** P wave reflected N-1 times from inner side of the CMB; N is a positive integer
- PKKPpre** a precursor to PKKP due to scattering near the CMB
- PKiKP** P wave reflected from the inner core boundary (ICB)
- PKNIKP** P wave reflected N-1 times from the inner side of the ICB
- PKJKP** P wave traversing the outer core as P and the inner core as S
- PKKS** P wave reflected once from inner side of the CMB and converted to S at the CMB
- PKKSab** PKKS bottoming in the upper outer core
- PKKSbc** PKKS bottoming in the lower outer core
- PKKSdf** PKKS bottoming in the inner core
- PcPP'** (alt: PcPPKP) PcP to PKP reflection at the free surface; other examples are PcPS', PcSP', PcSS', PcPSKP, PcSSKP

- SKS** (alt: S') unspecified S wave traversing the core as P
- SKSac** SKS bottoming in the outer core
- SKSdf** (alt: SKIKS) SKS bottoming in the inner core
- SPdifKS** (alt: SKPdifS) SKS wave with a segment of mantle-side Pdif at the source and/or the receiver side of the raypath
- SKP** Unspecified S wave traversing the core and then the mantle as P
- SKPab** SKP bottoming in the upper outer core
- SKPbc** SKP bottoming in the lower outer core
- SKPdf** SKP bottoming in the inner core
- S'S'** (alt: SKSSKS) Free surface reflection of SKS
- S'N** SKS reflected at the free surface N-1 times; N is a positive integer
- S'z-S'** SKS reflected from inner side of discontinuity at depth z outside the core, which means it is precursory to S'S'; z may be a positive numerical value in km
- S'P'** (alt: SKSPKP) SKS to PKP converted reflection at the free surface; other examples are S'SKP, S'PKS
- S'P** (alt: SKSP) SKS to P reflection at the free surface
- SKKS** Unspecified S wave reflected once from inner side of the CMB
- SKKSac** SKKS bottoming in the outer core
- SKKSdf** SKKS bottoming in the inner core
- SNKS** S wave reflected N-1 times from inner side of the CMB; N is a positive integer
- SKiKS** S wave traversing the outer core as P and reflected from the ICB
- SKJKS** S wave traversing the outer core as P and the inner core as S
- SKKP** S wave traversing the core as P with one reflection from the inner side of the CMB and then continuing as P in the mantle

SKKPab SKKP bottoming in the upper outer core

SKKPbc SKKP bottoming in the lower outer core

SKKPdf SKKP bottoming in the inner core

ScSS' (alt: ScSSKS) ScS to SKS reflection at the free surface;
other examples are: ScPS', ScSP', ScPP', ScSSKP,
ScPSKP

NEAR SOURCE SURFACE REFLECTIONS (Depth phases)

pPy All P-type onsets (Py) as defined above, which resulted from reflection of an upgoing P wave at the free surface or an ocean bottom;

WARNING: The character "y" is only a wild card for any seismic phase, which could be generated at the free surface.

Examples are: pP, pPKP, pPP, pPcP etc

sPy All Py resulting from reflection of an upgoing S wave at the free surface or an ocean bottom; For example: sP, sPKP, sPP, sPcP etc

pSy All S-type onsets (Sy) as defined above, which resulted from reflection of an upgoing P wave at the free surface or an ocean bottom;

For example: pS, pSKS, pSS, pScP etc

sSy All Sy resulting from reflection of an upgoing S wave at the free surface or an ocean bottom; For example: sSn, sSS, sScS, sSdif etc

pwPy All Py resulted from reflection of an upgoing P wave at the ocean's free surface

pmPy All Py resulted from a reflection of an upgoing P wave from the inner side of the Moho

SURFACE WAVES

- L** Unspecified long period surface wave
- LQ** Love wave
- LR** Rayleigh wave
- G** Mantle wave of Love type
- GN** Mantle wave of Love type; N is integer and indicates wave packets travelling along the minor arcs(odd numbers) or major arc (even numbers) of the great circle
- R** Mantle wave of Rayleigh type
- RN** Mantle wave of Rayleigh type; N is integer and indicates wave packets travelling along the minor arcs(odd numbers) or major arc (even numbers) of the great circle
- PL** Fundamental leaking mode following P onsets generated by coupling of P energy into the wave guide formed by the crust and upper mantle
- SPL** S wave coupling into the PL-wave guide; other examples are SSPL, SSSPL

ACOUSTIC PHASES

- H** A hydroacoustic wave from a source in the water, which couples in the ground
- HPg** H phase converted to Pg at the receiver side
- HSg** H phase converted to Sg at the receiver side
- HRg** H phase converted to Rg at the receiver side
- I** An atmospheric sound arrival, which couples in the ground
- IPg** I phase converted to Pg at the receiver side
- ISg** I phase converted to Sg at the receiver side
- IRg** I phase converted to Rg at the receiver side
- T** A tertiary wave. This is an acoustic wave from a source in the solid earth, trapped in a low velocity oceanic water layer called the SOFAR channel (SOund Fixing and Ranging)
- TPg** T phase converted to Pg at the receiver side

TSg T phase converted to Sg at the receiver side

TRg T phase converted to Rg at the receiver side

AMPLITUDE MEASUREMENT PHASES

A Unspecified amplitude reading

AL Amplitude reading for local magnitude

AB Amplitude reading for body wave magnitude

AS Amplitude reading for surface wave magnitude

END Time of visible end of record for duration magnitude

UNIDENTIFIED ARRIVALS

x (old: i,e,NULL) unidentified arrival

rx (old: i,e,NULL) unidentified regional arrival

tx (old: i,e,NULL) unidentified teleseismic arrival

Px (old: i,e,NULL,(P),P?) unidentified arrival of P-type

Sx (old: i,e,NULL,(S),S?) unidentified arrival of S-type