Goal & Scientific Objective
SAFOD is driven by the need to answer fundamental questions about the physical and chemical processes controlling faulting and earthquake generation within a major plate-bounding fault zone. The principal goals of SAFOD are to (i) study the structure and composition of the San Andreas Fault at depth, (ii) determine its deformation mechanisms and constitutive properties, (iii) measure directly the state of stress and pore pressure in and near the fault zone, (iv) determine the origin of fault-zone pore fluids, and (v) examine the nature and significance of time-dependent chemical and physical fault zone processes (Zoback et al., 2007).

Operational Achievements
Pilot Hole (SAFOD-PH): vertical, 2168 m depth, complete downhole logs, no core

Main Hole (SAFOD-MH): deviated, 3993 m depth, intersects SAFZ between 3100-3400 m, drill core from 1462-1468 m, 3056-3067 m, 3990-3993 m plus 60 side wall cores, downhole logging by OSG, USGS and service companies

SAFOD-III: four side tracks penetrating the SAFZ at depth, side track E contained core from 3141 to 3154 m, side track G contained core from 3191 to 3200 m and from 3300 to 3313 m

Data & Sample Access
Data holdings from the SAFOD Project can be accessed on the ICDP and the Northern California Earthquake Data Center (NCEDC) website. SAFOD physical samples are curated at the Gulf Coast Repository at Texas A&M University, under the supervision of John Firth (firth@iodp.tamu.edu)

Web & Media Resources
www.earthscope.org/science/observatories/safod
http://safod.icdp-online.org
http://earthquake.usgs.gov/research/parkfield
www.youtube.com/watch?v=yJ3zql8SkIY
www.youtube.com/watch?v=pUgxXqwdOlg

Timeline
2002 Pilot Hole Drilling (SAFOD-PH)
2004 Phase I Main Hole Drilling (SAFOD-MH)
2005 Phase II Main Hole Drilling (SAFOD-MH)
2007 Side Tracking (SAFOD-III)

Principal Investigators
Mark D. Zoback, Stanford University
Stephen H. Hickman, USGS Menlo Park
William L. Ellsworth, USGS Menlo Park

Schematic cross section of the San Andreas Fault Zone showing the SAFOD wells (Source: USGS)
Scientific Findings

At SAFOD, the San Andreas Fault Zone is located between ~3150 to 3420 m depth, containing several discrete 2–3 m wide zones that exhibit very low P- and S-wave velocities and low resistivity.

Two of these zones are actively creeping and have progressively deformed the casing at measured depths of 3192 m and 3302 m.

The deformation zones are composed of highly foliated, incohesive fault gouge. Fault weakening is mainly driven by talc-bearing serpentine, saponite, and/or nano-coated clay minerals.

No evidence for high pore pressure was observed in the SAFZ which supports fault weakening models by low friction clay minerals. The SAF hydrologically separates Pacific Plate from North American Plate but serves partly as conduit for mantle-derived fluids.

Changes in seismic velocity caused by coseismic stress changes were monitored few hours before two earthquakes, suggesting that they may be related to pre-rupture stress induced changes in crack properties.

Key Publications


