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IODP Proposal Cover Sheet

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☒ **New** ☐ **Revised** ☐ **Addendum**

Please fill out information in all gray boxes

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Title:	Monitoring strain with IODP CORK observatories: A geodynamic transect across the Juan de Fuca plate		
Proponent(s):	Earl E. Davis, Keir Becker, and Kelin Wang		
Keywords: *(5 or less)*	Geodynamics, plate tectonics, earthquake processes, hydrogeology	Area:	Northeast Pacific

Contact Information:

Contact Person:	Earl E. Davis		
Department:	Pacific Geoscience Centre		
Organization:	Geological Survey of Canada		
Address	9860 W. Saanich Rd., Sidney, B.C., V8L 4B2, Canada		
Tel.:	01 250 363 6453	Fax:	01 250 363 6565
E-mail:	edavis@nrcan.gc.ca		

Permission to post abstract on IODP-MI Sapporo Web site: ☒ Yes ☐ No

Abstract: (*400 words or less)*

In this preliminary proposal, we provide a "template" for a study of the temporal and spatial variation of seismic and interseismic strain across the Juan de Fuca plate from the Cascadia subduction zone to the nearby Juan de Fuca Ridge. The study would involve very long-term formation pressure monitoring in a transect of nine holes instrumented with simple casing strings that could be either drilled or reamed in. The template complements ongoing hydrologic studies on the Juan de Fuca Ridge flank and a planned study of methane hydrates on the Cascadia margin. We will coordinate efforts with these studies scientifically and logistically, although the focus of this proposal is entirely on studying intra- and inter-plate motion and deformation; monitoring must target hydrologically isolated formational horizons. Efforts will also be coordinated with planning for the Neptune cabled observatory network, which will include other types of strain monitoring (e.g., acoustic and GPS horizontal ranging and bottom pressure vertical deformation) and seismic and hydrothermal observatories, and will provide power and communications for the installations. The subduction part of the template is complementary with the NanTroSEIZE complex drilling proposal, and if advised to do so, the proponents will explore specifically how it can be applied at that location.

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Scientific Objectives: (*250 words or less*)

Stated most simply, the objective of this work is to watch a tectonic plate move. Episodic motion is known to occur on the boundaries of plates (spreading, transform, and subduction); this is often, but not always, accompanied by seismic energy release. Previous hydrologic monitoring experiments in ODP boreholes have demonstrated the effectiveness of formation-pressure monitoring to observe volumetric strain both at and well away from plate boundaries. Herein, we propose to establish a systematic transect of instrumented boreholes distributed from a ridge axis to a subduction zone that will allow observations of 1) plate boundary strain that cannot be detected with conventional (e.g., seismic, acoustic ranging) means, 2) the reaction of a plate (as it varies in space and time) to episodic strain on its boundaries (detected by any means), and 3) inter- or intra-plate strain of an unanticipated nature (e.g., is "steady" plate motion away from boundaries not as steady as we think?). The observatories will also provide important seismic (surface waves are well resolved with current-generation pressure sensors) and oceanographic data (for observing storm surges, seasonal and decadal oscillations, and tsunamis, and for combining with satellite altimetry and gravity measurements).

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

The work proposed is non-standard in several respects. It will not require coring or logging, although both could be done as part of operations at any of the sites. The technology to be used will be some simplification of either CORK or ACORK instrumented casing strings. The simplest would involve only a single pipe trip. Use of a drill-in-and-release system is possible because all of the holes will terminate in sediment whose compositions and properties are already known and benign. Engineering and other details will be discussed with appropriate IODP groups once we are requested to develop a mature proposal. Adequate sensitivity of formation pressure to strain has been well demonstrated in theory and practice (see references). Long term strain signals can be detected in the sediment sections targeted by virtue of their low permeability and thickness; hydrologic time constants of the order of decades to 100's of years are anticipated. Another non-standard technology that will be desirable, but not necessary, will be a cable connection for power and communications via the planned Neptune observatory network. Newly-improved CORK monitoring electronics allow autonomous sensing and data storage for periods of up to 15 years (i.e., battery shelf life), but a cable connection would allow real-time access to data (benefiting seismic and tsunami monitoring) and reduce greatly the need for submersible site visits to download data. The proponents are working closely with the Neptune planning efforts to make this possibility a reality.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
ODP Site1023	47°55.0'N 128°47.5'W	2600	150	0	150	22 km to ridge axis
ODP Site1024	47°54.5'N 128°45.0'W	2600	130	0	130	26
ODP Site 1025	47°53.3'N 128°39.0'W	2600	75	0	75	34
ODP Site1029	47°49.9'N 127°22.6'W	2600	190	0	190	55
ODP Site1027	47°45.4'N 127°43.8'W	2600	500	0	500	103
DR-2 (Proposal 545)	47°37.5'N 127°20.0'W	2600	800	0	800	142
CAS-04B (Proposal 553)	48°34.0'N 127°10.0'W	2600	1000	0	1000	160 (near prism toe)
CAS-01B (Proposal 553)	48°42.0'N 126°52.1'W	1400	800	0	800	185
CAS-05B (Proposal 553)	48°46.0'N 126°43.5'W	1100	800	0	800	200