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The Canterbury, New Zealand Earthquake Sequence: Tectonic Context and Seismological Consequences

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The deadly and damaging Christchurch Earthquake of February 22, 2011 (23:51, 21/02/11 UTC) is part of the Canterbury earthquake sequence started by the Mw 7.1 Darfield Earthquake in September of 2010. These earthquakes have occurred on previously unrecognized fault(s) and significantly distant from the main components of the plate boundary system through South Island, New Zealand. The initial rupture pattern of the September event and subsequent aftershocks have delineated a linear (nearly east-west in orientation) trend of seismicity extending from the foothills of the Southern Alps to the Pacific coast to the east of the city of Christchurch. Additionally, the eastern segment of the fault system, illuminated by the seismicity, is generally bounded to the south by the Banks Peninsula, a Late Miocene aged volcanic complex. Understanding the relationships among the various fault segments, the regional geologic structure, and crustal stresses associated with regional plate interactions (further modified by the earthquakes) is key to placing these events into a context allowing their lessons to be applied elsewhere. We have focused on this aspect of the seismo-tectonics of the sequence with an aim at addressing the following: 1) How does the February 22 event's fault relate to the September 22 fault system both physically and through stress conditions; 2) What role has the spatial distribution of aftershocks played in reducing moment-release gaps between fault segments; 3) Are there other faults capable of hosting moderate but damaging earthquakes in the region; and 4) Can we say anything about the potential for future events such as the February 22 earthquake? This last point is the fundamental question that Christchurch residents would like answered.