Hydrofracture dilatancy and the development of quartz-vein arrays in the Wattle Gully Fault Zone, Victoria. S. F. Cox,* M. A. Etheridge,† V. J. Wall,* and T. F. Potter,‡ * Department of Earth Sciences, Monash University, Clayton, Victoria, Australia, 3168, † Bureau of Mineral Resources, P.O. Box 378, Canberra, A.C.T., Australia, 2601, ‡ Chewton Gold Associates, Chewton, Victoria, Australia, 3451.

Hydrofracture dilatancy associated with faulting at high fluid pressures has generated major quartz-vein systems in many reverse fault zones which developed during regional deformation and low-grade metamorphism in the Bendigo Trough, Victoria.

Within the Wattle Gully Fault Zone dilatancy has occurred both within faults and in hydraulic fracture arrays adjacent to faults. The overall geometry of quartz-vein arrays reflects development in a stress regime in which the far-field σ_1 axis was oriented approximately E–W, and the far-field σ_3 axis was approximately vertical. Complex vein geometries adjacent to many faults reflect the influence of various factors including local stress reorientation, vein rotation and mechanical anistropy of the wall rocks.

Vein growth typically involved cyclic crack–seal growth histories. Microstructures indicate that vein growth involved up to 2×10^3 growth increments per centimetre of vein width, and that both sub-critical and unstable crack growth mechanisms were involved in the development of fracture arrays.

Evidence from the Wattle Gully Fault Zone points to a faulting mechanism in high fluid-pressure regimes in which the cyclic development of hydrofracture dilatancy accompanied cyclic build-up of fluid pressure and shear stress prior to slip events. Shear failure can occur in response to increasing fluid pressure reducing the shear strength of the fault zone to the level of the tectonic shear stress. Slip events are expected to be accompanied by rapid, local relief of fluid pressure and shear stress, and to result in 'fluid-loss hardening' of the fault zone, as well as partial collapse and sealing of dilatant fracture arrays.

The Bermagui megakink and associated structures. T. J. Cudahy, School of Earth Sciences, Macquarie University, North Ryde, New South Wales, Australia, 2113.

The coastal greywackes and slates in the easternmost Lachlan Fold Belt are deformed into tight, upright folds with an associated well-developed axial-plane cleavage; the bedding and cleavage forming a subvertical anisotropy available for later deformation. The last deformation was a N–S compression, resulting in a variety of structures, for example: megakinks (tens of kilometres); second-order kinks (hundreds of metres); outcrop-scale kinks and buckles (centimetres to metres); microfolds and pressure-solution surfaces (seen in thin section); joints, faults and shear zones.

Outcrop-scale kinks developed in all megakink and second-order kink domains, and calculated compression directions indicate that the principal compression axis, σ_1, was subhorizontal and parallel to the vertical anisotropy, even though some domains are oriented up to 90° to the regional meridional trend. The simplest model of compression is that all the domains were parallel when the outcrop-scale kinks formed, and were later rotated into their present megakink form. Furthermore, the variation in the relative proportions of sinistral and dextral kinks around the Upper Devonian synclinal keel (a dominance of sinistral kinks in the eastern periphery and dextral kinks on the western side) suggest a refraction of the principal compression axis, such that σ_1 remained horizontal but became more oblique to the synclinal keel.

The Upper Devonian synclinal keel was not significantly deformed during kinking (apart from jointing), and caused an area of high strain to develop around its periphery. This high-strain zone is expressed by concentrations of outcrop-scale kinks and the second-order Murrah kink zone. Overprinting relations enabled the following order of structural events to be determined: (1) outcrop-scale kinking and jointing; (2) formation of sinistrally and dextrally oriented cleavage and (3) mega- and second-order kinking.

Problems of structural correlation in accretionary prisms. I. W. D. Dalziel, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964, U.S.A.

Metamorphic and sedimentary rocks of the Scotia Ridge represent material accreted to the West Antarctic margin of Gondwanaland before and after fragmentation of the supercontinent. The metamorphic complexes include rocks of oceanic affinities and are interpreted as having been carried to considerable depths (>20 km) beneath an accretionary prism. The sedimentary strata are interpreted to have been deposited in trench-slope basins.

The metamorphic rocks display a remarkably similar history of polyphase ductile deformation along several hundred kilometres of the continental margin. Yet some of them were deformed prior to the Late Jurassic or Early Cretaceous and others may be as young as Cenozoic. The sedimentary sequences are everywhere deformed by tight to sub-isoclinal asymmetric 'main phase' folds with an accompanying axial-plane cleavage, and also by subsequent 'late phase' open folds and kink bands. Yet they were probably deposited in several discrete basins.

The problems raised by these field relations and other data with regard to structural correlation in accretionary prisms were discussed.

A multiply deformed terrain in southern British Columbia: exploration for Ag–Pb–Zn sulphide deposits. G. J. Dickie, Minequest Exploration Associates Limited, 311 Water Street, Vancouver, B.C. V6B 1B8, Canada.

Numerous sulphide deposits bearing Ag–Pb–Zn occur in a sequence of slightly metamorphosed sedimentary and volcanic strata of Late Palaeozoic age in south-central British Columbia. The deposits are stratiform in character but are discontinuous. The enclosing strata have a strongly developed foliation sub-parallel to lithologic boundaries and regional and detailed mapping shows that the foliation is parallel to the axes of F_1 isoclinal folds. Bedding is at a high angle to the foliation at the fold hinges. Sulphide beds show some attenuation on the F_1 limbs and consequent thickening at the fold hinges. A second set of folds, F_2, with axes oriented E–W has also produced thickening of sulphide beds in the hinge areas of minor folds, emphasizing the concentration of sulphides in structurally controlled positions. Minor thrust faults along and across the foliation occur on the small scale and are assumed to exist at a larger scale thereby explaining some discontinuities in stratigraphy. Third-phase folds, F_3 are open with N–S axial planes spatially related to normal faults and have no significant effect on sulphide disposition. In this structural setting, the most likely location for a major sulphide accumulation is at the culmination of a large F_1 fold. Smaller deposits could be localised within the hinge areas of F_2 folds. The target shape for sulphide deposits is a linear plunging body and exploration patterns have been directed accordingly.

Attitude variation of en échelon fractures in generalized Riedel experiments. D. W. Durney, School of Earth Sciences, Macquarie University, North Ryde, New South Wales, Australia, 2113.

One of the interesting characteristics of en échelon fracture systems is the wide range of dihedral angles they display between individual fractures and the plane of the parent array. For en échelon veins this is from almost 0° up to about 85°. This note reports a series of simple experiments which are designed to test the writer's theoretical prediction that the angle of fracture propagation is variable and depends on the degree to which the material in the shear zone dilates or contracts during the deformation (incremental dilational shear hypothesis). For dextral zones the relationship is

$$\phi^{\delta} = \psi^{\delta}/2 - 45^\circ \qquad (-90^\circ < \phi < 0^\circ)$$

where ϕ^{δ} is the principal incremental shortening direction and ψ^{δ} is the incremental displacement direction, given by

$$\tan \psi^{\delta} = \delta\Delta/\delta\gamma.$$

$\delta\Delta/\delta\gamma$ is the ratio of incremental volumetric or area strain to incremental shear. (In plane-strain conditions this is the dilatancy.)

The reported experiments are based on W. Riedel's clay-boards experiments of 1929, with the important additional facility of a controlled, oblique, displacement path (ψ^{δ}). En échelon extension fractures were reproduced under three different values of zone displacement angle: $\psi^{\delta} = +45^\circ$ (divergent shear), $\psi^{\delta} = 0^\circ$ (simple shear) and $\psi^{\delta} = -45^\circ$ (convergent shear). In all three runs the observed fracture propagation angles fit the predicted angles (ϕ^{δ}) to within the limits of