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Erratum to “Theories and applicability of grain size piezometers: The role of dynamic recrystallization mechanisms” [J Struct Geol 30 (2008) 899–917]

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The author wishes to correct the following errors in a previously published paper, as cited above.

1. In Section 4.1, the exponents for the relation between dynamically recrystallized grain size d and flow stress σ, as derived by the nucleation-and-growth model of the Derby–Ashby model (Derby and Ashby, 1987; Derby, 1990, 1991) were summarized as

$$\Delta Q = Q_{gb} - Q_c, p = \frac{n}{2}, m = 2. \tag{15}$$

This yielded a grain size exponent $p = 1.5$ for an ideal stress exponent $n = 3$ of recovery creep. However, Derby (1992) reported a significant error in the Derby–Ashby model concerned with statistical calculation. When this error is corrected, p changes by a factor of two, i.e.,

$$\Delta Q = Q_{gb} - Q_c, p = n, m = 2. \tag{15'}$$

The corrected calculation yields $p = 3$ for the typical case of $n = 3$. Based on the corrected data, we revised Table 1 and Fig. 6 as shown below. The predictions made by the corrected Derby–Ashby model for discontinuous dynamic recrystallization (DDRX) show a marked deviation from the p values observed in DDRX (Fig. 6b). However, as noted by Derby (1992), “the failure of this specific model does not invalidate the dynamic balance concept”. Indeed, the basic scaling equations between nucleation and growth rates used in the Derby–Ashby model have been verified from a stochastic theory of grain size distribution (Shimizu, 1998a, 1999). Notably, the range of p values for DDRX, except for a single datum (Sah et al., 1974, Ref. 26 of Fig. 6a), is 1.3–1.4, which agrees well with $p = 1.33$ obtained from the marginal nucleation model of Shimizu (1998b), although this model focuses on continuous dynamic recrystallization (CDRX). In the Derby–Ashby model, the rate of bulge nucleation is assumed to be controlled by subboundary formation at grain boundaries. Similarly, the marginal nucleation model of Shimizu (1998b) calculates the rate of subgrain formation at grain margins. Hence, the σ–d relations in DDRX may be explained based on the Shimizu model of marginal nucleation-and-growth, possibly with minor modifications, rather than using the Derby–Ashby model.

2. Incorrect equation numbers were cited in the legend in Fig. 6.
3. An incorrect equation number was cited in Table 3.
4. In the nomenclature provided in Appendix F, the unit of mobility M should be corrected as follows:

M mobility of a grain boundary [$\mathrm{J^{-1}\,m^4\,s^{-1}}$]

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Table 1
Classification of DRX mechanisms and applicability of grain size models.

DRX	State	Mechanism	Grain size model	p	m	ΔQ
DDRX	Steady	BLG+GBM	Derby & Ashby (1987)	n[a]	2	$Q_{gb} - Q_c$
CDRX	Transient	SGR	Twiss (1977)	1[b]	-	-
	Transient	SGR	Edward et al. (1982)	n/4[b]	4	$Q_v - Q_c$
	Steady	Marginal SGR+GBM	Shimizu (1998b)	1.33	3	$Q_{gb} - Q_v$
	Steady	intracrystalline SGR+GBM	Shimizu (1998b)	1.25	4	$Q_{gb} - Q_v$
Any	Steady	DRX+Nabarro-Herring creep	De Bresser et al. (1998)	$(n - 1)/2$	2	$Q_v - Q_c$
	Steady	DRX+Coble creep	De Bresser et al. (1998)	$(n - 1)/3$	3	$Q_{gb} - Q_c$

[a] Correction by Derby (1992).
[b] Values for subgrain size.

Parameter	Value	Remarks	Source
K'	7.8	Calculated by Eq. (B.12)	

(Correction to Table 3).

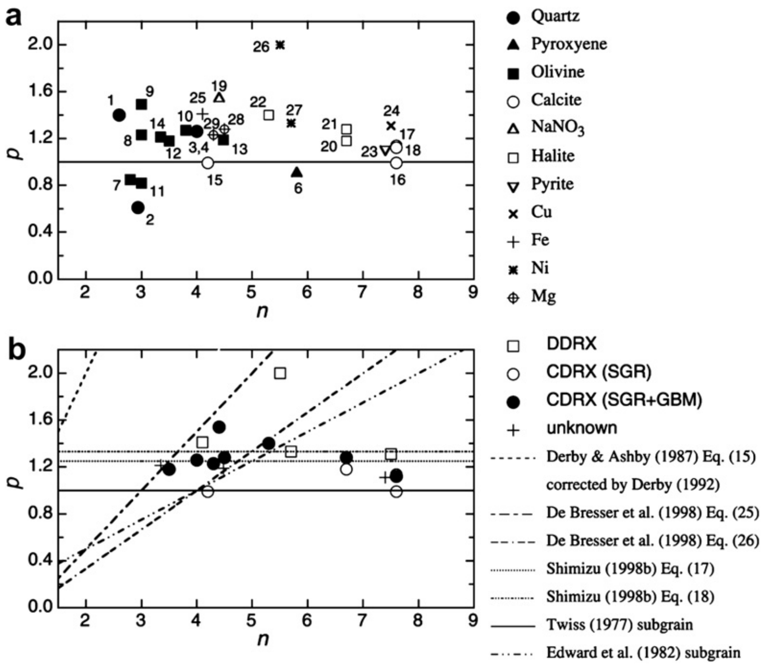

Fig. 6. (a) Stress exponent p of recrystallized grain size plotted against the power law exponent n of dislocation creep for a wide range of materials, after Table 2. Numbers correspond to the data sources listed in Table 2. (b) Comparison of scaling parameters p and n calibrated in laboratory studies and those predicted theoretically. The data obtained from solid-medium apparatus are omitted. DRX mechanisms are classified according to Fig. 1.

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References

Derby, B., 1990. Dynamic recrystallization and grain size. In: Barber, D.J., Meredith, P.G. (Eds.), Deformation Processes in Minerals, Ceramics and Rocks. Unwin Hyman, London, pp. 354–364.
Derby, B., 1991. The dependence of grain size on stress during dynamic recrystallization. Acta Metallurgica and Materialia 39, 955–962.
Derby, B., 1992. Dynamic recrystallization: The steady state grain size. Scripta Metallurgica and Materialia 27, 1581–1586.
Derby, B., Ashby, M.F., 1987. On dynamic recrystallization. Scripta Metallurgica 21, 879–884.
Sah, J.P., Richardson, G.J., Sellars, C.M., 1974. Grain size effects during dynamic recrystallization of nickel. Metal Science 8, 325–331.
Shimizu, I., 1998a. Lognormality of crystal size distribution in dynamic recrystallization. FORMA 13, 1–11.
Shimizu, I., 1998b. Stress and temperature dependence of recrystallized grain size: A subgrain misorientation model. Geophysical Research Letters 25, 4237–4240.
Shimizu, I., 1999. A stochastic model of grain size distribution during dynamic recrystallization. Philosophical Magazine A79, 1217–1231.